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AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineers

SEPTEMBER 1931

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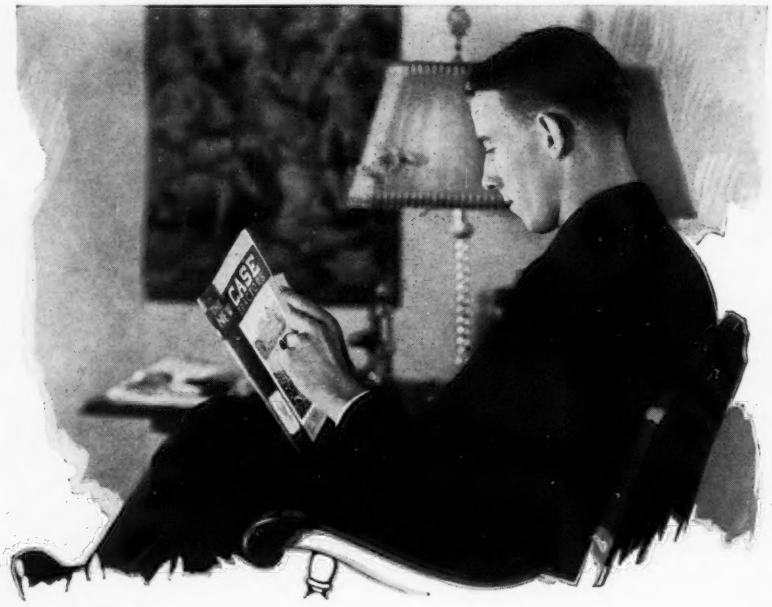

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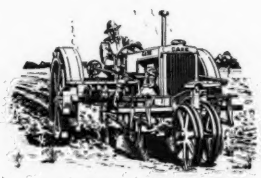

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Published by the AMERICAN SOCIETY of AGRICULTURAL ENGINEERS, Saint Joseph, Michigan

Publication Office, Bridgman, Michigan. Editorial and Advertising Departments, Saint Joseph, Michigan

L. J. FLETCHER, President — RAYMOND OLNEY, Secretary-Treasurer

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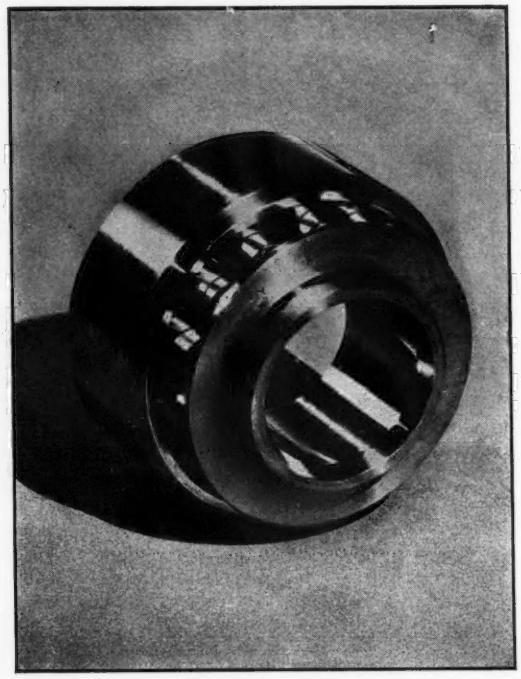
Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to members of the Society, $2.00 a year. Postage to countries to which second-class rates do not apply, $1.00 additional. Entered as second-class matter, October 8, 1925, at the post office at Bridgman, Mich., under the Act of August 24, 1912. Additional entry at St. Joseph, Mich. Acceptance for mailing at the special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized August 11, 1921. The title AGRICULTURAL ENGINEERING is registered in the U. S. Patent Office.



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AGRICULTURAL ENGINEERING

Volume 12 SEPTEMBER, 1931 Number 9

The Place and Function of Land Reclamation in the Agricultural Program[1]

By James A. King[2]

James A. King

AT THE time of undertaking this task, my thought was to prepare a paper which could be presented to this meeting as the official expression of the Land Reclamation Division of the Society. Before the three months available to me for preparing this paper were half gone, it became very evident that this plan was physically impossible. Consider the fact that in 1926 the Irrigation Division of the American Society of Civil Engineers appointed a committee to draft an expression of policy which should set forth the official attitude of that society toward the one reclamation activity of irrigation. It took that committee two years to draft their preliminary report. Now, after the lapse of three additional years, the preliminary report of that committee is still under discussion by the membership of the division and has not yet been adopted as the official expression of the division. Thus, you will realize the utter impossibility of my preparing in three months a paper dealing with the entire field of land reclamation, instead of only one of its major subdivisions, which would have received the endorsement of the entire membership of the Land Reclamation Division of this Society.

Therefore, I abandoned my original idea of an official communication from this division. Nevertheless. I have drawn liberally on a large number of my fellow members of this division for ideas, suggestions, material, advice, and criticisms. Copies of my first rough draft were submitted to about a dozen fellow members for criticism, much of which has been incorporated into the final draft herewith presented. Thus, while this paper is not strictly the work of one man, yet it is only fair to his advisors and to all other members of this division that this one man should assume full responsibility for all that is said in this paper. I therefore assume that responsibility. At the same time, as an act of justice and as a mark of my appreciation, full credit is hereby given my cooperators whose names are listed at the end of this paper for the invaluable assistance given by them, and without which this paper would not have been possible.

On this quarter-century anniversary of the formation of this society, it is fitting and proper that we should take stock of ourselves, of our aims, purposes, and accomplishments. That is what I want to do for the Land Reclamation Division and also for the underlying principles of reclamation which are deemed basic by this division of our society. I want to set before you the elements of the faith and the belief that is within us. Then I want to justify these by giving you a panoramic view of what reclamation has already done for this nation, and of what still remains for us to do.

This is the American Society of Agricultural Engineers. If the Land Reclamation Division is true to the ideals and ethics of the parent society, if it is true to the trust which it has assumed by the very act of its existence as an entity, it must be **American**, not regional or sectional, in its basic principles, its fundamental viewpoint, its guiding ideals, and the standards by which it measures the wisdom or the rightness of any policy or recommendation.

I would be unfaithful and traitorous to the trust and the confidence reposed in me by my associate members of this division in asking me to address you today in its behalf if I did not by every word of mine picture for you a **national** problem, and a **national** viewpoint and policy growing out of a **national** attitude of mind.

So let us wipe from our minds any bias which may be lurking in some inner recess. Let us consider a national problem, policy and program solely from a national viewpoint.

The general thesis of the Land Reclamation Division of this society is built up on certain truths which are so basic, so fundamental, and so self-evident that we look upon them as being axioms.

1. Agriculture is the foundation of our American civilization. Our industrial, economic, and social life have grown up out of our agriculture as any gorgeous plant grows out of the soil, and they cannot long endure or progress when our agriculture is languishing or retrogressing.

2. The soil is to any system of agriculture what its production plant is to any manufacturing industry or business. Here the raw materials of heat, light, air, moisture and chemical compounds are assembled and transmitted into cereals, fruits, and forage.

3. The chief objective of individual, regional, and national agriculture is to build and maintain a continuingly profitable industry which is also a wholesome and satisfying mode of life.

4. In order to accomplish this objective, the nation, the region and the individual farmer must have a soil that is a profitable manufacturing plant, and must maintain it in such condition that it will continue to produce on a profitable basis. If it cannot be so maintained, it must be abandoned as agricultural soil, and other soil that can be made to produce profitably must be secured and utilized.

5. All soil should be used for that purpose and in that manner in which it will pay the largest profit to its operators and, at the same time, render the largest measure of worthy service to the community, the state, and the nation.

Out of these axioms this division of our society has evolved the following definition of Land Reclamation:

"Land Reclamation involves putting agricultural land to that use in which it will render the largest possible benefits to both the owner and the general public—whether this be production of crops or the furnishing of recreation —and increasing the benefits to be obtained by the proper use of that land to the highest point commensurate with the cost involved."

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[1]Paper presented at the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June, 1931.

[2]Advertising and publicity manager, Mason City Brick & Tile Co., Mason City, Iowa. Mem. A.S.A.E.

We hold it to be true and sound that a persistent food surplus is publicly wholesome, and is more to be desired than is a persistent balance between supply and demand. Such a persistent surplus is always the forerunner of and the underlying stimulus to the development of new industries, new economic wealth, and new social services. On the other hand, a persistent balance between supply and demand tends to maintain the status quo and to retard growth and development

We have gone further and have elaborated this definition into a creed, or articles of faith, or you might even call it a code of ethics, for the guidance of this division as a group and of its individual members in what it and we shall advocate and do in the promotion and practice of land reclamation. This creed of ours may be stated briefly as follows:

1. By agricultural lands we mean not only those that are now being used for the production of crops, but also those not now so used but which possess the latent possibility for such use.

2. We believe that it is even more important to improve lands that are now used for agricultural purposes so that they will produce to the highest possible degree of their potential productivity than it is to bring into production lands that are now agriculturally idle.

3. We believe that if lands which are now agriculturally idle can be economically made to produce more profitably than is possible with other lands now in agricultural use, then such idle lands should be placed in production if there is no higher or more worthy service which they can render the nation; and even though by so doing, it becomes necessary or advisable to put the less profitable lands to some use other than agriculture. However, such shifting in utilization of land in large areas should be started only after most careful study of economic and sociologic problems and effects.

4. We believe that the control of the movement of both soil and water is fundamental to soil productivity and that such control constitutes a legitimate field of activity for the Land Reclamation Division of the American Society of Agricultural Engineers.

5. We believe that the basic problems involved in the fundamental economics of improvements made for the control of soil erosion and water movement are so far reaching in their effect that these should be given careful consideration in any land reclamation project or policy.

6. We believe that there should be more complete cooperation and coordination than now exists between the various state and federal institutions and private interests which have undertaken or are affected by activities connected with individual phases of these problems.

The Land Reclamation Division of this society holds this to be a truth:

In general, no new continent—no new major portion of an occupied continent—can be settled and developed into a well rounded, stable and safe society until its agriculture has been developed to such a point that the major food requirements of its population—whatever its density of population may be—can be supplied from local production. The industrial and social development of such an area or region can progress safely and healthfully only in proportion to, or at the rate at which its agriculture is developed. We hold this to be a truth in spite of the few important historical exceptions which may be quoted by those who disagree with us.

We also hold it to be true and sound that a persistent food surplus is publicly wholesome, and is more to be desired than is a persistent balance between supply and demand. Such a persistent surplus is always the fore-runner of and the underlying stimulus to the development of new industries, new economic wealth, and new social services. On the other hand, a persistent balance between supply and demand tends to maintain the status quo and to retard growth and development.

Not until the human race—in its struggle to rise above the wild beasts surrounding it—had been released from the constant fear of hunger by the existence of a food surplus, could it divert some its time and energies to things other than the acquiring of food. Only then did man begin to grow away from the wild beasts and to lay the first foundation stones of human culture and civilization.

Each new and distinct step in human progress has followed and has grown out of a persistent increase in and surplus of available food supply. On down through the future cycles of time this same basic principle will continue to function and to manifest itself in new eras of human development. And each such era will be preceded by, and will grow out of, a persistent surplus in food supplies.

This may be illustrated from the history of the Western hemisphere, as well as by practically each and every major region of America, in the following order of events:

1. The first settlements on the new continent were made by overflow populations from the most congested regions of Europe.

2. Each region of this new continent was explored by adventurous scouts, hunters, and trappers — the advance guards of civilization. Their impressions of the region were taken back to less venturesome relatives and friends, some of whom became enthused by the lure of these new lands.

3. The less conservative residents of the older and more thickly settled regions ventured out into these new regions and opened up and developed farms. At first the population was almost entirely rural — actually living on and operating their farms.

4. Villages and towns grew up as they were needed to serve the economic and social needs of this farming population. At first, these were nothing more than trading centers where the farmers exchanged their surplus products for the manufactured goods which they needed in the conduct of their farming business, or desired in their homes.

5. Small manufacturing industries developed in certain of these towns. Most of these were started simply to supply local needs for manufactured goods that were being brought in from older regions at considerable delay and expense, or to produce on a commercial scale things that were being made laboriously by hand in the homes. Others of these manufacturing industries processed the raw products of the farms, or of local timber and mineral resources, and shipped these into the older or more densely settled portions of the world.

Thus, these villages, towns and small cities were literally built up out of the surplus products of the farms which they served. The size and importance of each town or city was determined by the extent and the productivity of the farming territory which it served.

Gradually, each region became more or less self-sufficient and self-sustaining economically and socially. Unconsciously, but under the operation of natural laws, they had tended to become a balanced, economic unit, such as is the state of Iowa today when the actual value of her manufactured goods is practically the same as the value of her farm products.

Several of the older regions have reached a fifth stage in their agricultural development. As the more aggressive manufacturing industries have pushed their products into

wider and ever wider markets, these regions have become unbalanced. The non-farming population became larger and still larger because of this growth of industry and business. Finally, the local food production was not large enough to supply the consumers' demand.

The increasing local demand for food stimulated local production to new levels. Some of the lands that were among the first to be put under cultivation had begun to show signs of diminishing yields. Some farmers sought to enlarge their production to meet the growing demand by breaking up lands that had not been so attractive or so amenable to cultivation in the pioneer days when land was abundant and the region produced more than it consumed. Others sought to rejuvenate their worn out soils. The food demand grew until local lands could not supply it, and food was imported from the newer regions which had a surplus production of food. Before such a region realized the fact fully, it had been confronted by the problem of land reclamation in all its phases.

The Atlantic Coast region was the first section of America to reach this fifth stage in its agricultural development. In some sections this stage had been reached before the United States became an infant among the independent nations of the world.

In fact, George Washington, himself, farmed impoverished soils. He farmed fields that had been cropped longer than have most of the fields in Iowa today. The father of our country faced the necessity of either restoring the fertility of his impoverished soils—as he actually did do by applying river muck to some of them—or of abandoning them and taking new, virgin soils in their place. He was much intrigued by this latter alternative. Only the public responsibilities thrust upon him by the Revolutionary War prevented him from realizing his dream of a vast, princely estate west of the mountain barrier through which he had penetrated on various earlier scouting expeditions, and patterned after that of his old time friend, Lord Fairfax, whose regal holdings Washington had managed in addition to his own extensive holdings.

The Ohio Valley region where Washington had dreamed of establishing a ducal domain has long been in this fifth stage of its agricultural history where its food consumption is greater than its production, with the attendant problem of worn out soils tion. The old South has long struggled with the problem of worn out soils to be rejuvenated if possible; where not, to be replaced by new soils from cut over timber regions, or by the drainage of swamp lands, and of maintaining the potential possible production of all its land under a regime of exportation of soil products. The Mississippi Valley region is fast approaching the culmination of the fourth stage of its agricultural development with its attendant problems of land reclamation.

The great plains, the inter-mountain and Pacific Coast regions are in various degrees of the second and third stages. Their reclamation problem is practically that of opening up new regions of food production as fast as can be utilized advantageously by the overflow population from the older Eastern sections, and building these newly opened areas into well balanced, self-sustaining economic and social units of the nation.

Thus our nation has been developed down to the present time; only thus will it be further developed on a sound and stable basis in the future. Each unit has been built upon its own local agriculture. Each unit has been built out of its own local agriculture and that of such more distant parts of the world as it may serve. The remaining vast, vacant spaces of our national domain will be occupied ultimately by a stable civilization only when, as, and if this civilization is built upon and out of a stable and a profitable agriculture.

The pioneer farmer with his plow always has been and always will be the first essential artisan in building each unit of our American civilization. Wherever this pioneer farmer has gone, land reclamation has preceded him to choose his new location for him. Wherever he struck the point of his plow into the earth, there land reclamation has pitched its tent, unobserved, and there it has stood quietly by until he should recognize its presence and call upon it for wisdom and guidance.

Thus, you will see that land reclamation is not only the foundation of our national agricultural development, but that it also is an essential factor in the entire framework of the superstructure. Like all the distinct units of the great science of agriculture, its problems and methods of procedure have been organized and correlated into a well defined science and art only after the various elements had been in operation a good many years.

It is still young as an organized science, if I may be permitted to call it a science at all. Its store of knowledge, its wisdom and judgment, its skill in functioning are growing rapidly. Mistakes have been made in the past. Some of these have made the word, "reclamation", anathema and a term of ill repute in the minds of many people. Naturally we deplore these mistakes, probably even more than does anyone else, because practitioners of our youthful science have been involved in making them. But, we deny most emphatically the claim that those mistakes establish the unsoundness of the fundamental principles of the science of land reclamation any more than the crimes committed or the mistakes made in the name of religion or medicine prove a wrongness inherent in these great humanitarian sciences. The accumulated knowledge of what not to do, and how not to do a thing, resulting from these mistakes reduces the probability of similar mistakes being made in the future.

Making the first round in building a new terrace. Terracing is one of the most important ways of controlling soil and water movement on cultivated land

We believe that in the future there will be found a greater need than ever before for the development and the application of the science of land reclamation. We see a large task remaining in guiding the development of idle lands and unoccupied regions. With all that has been learned about the evil effects resulting from wrong and faulty methods of operating farm lands, we believe we can do much to prevent the further dam-

age of lands now in use and can accomplish much in protecting new lands that may be opened up against the ravages which have been visited upon older lands because of inadequate original protective measures, or faulty methods of operation. We look forward to the development of new ways in which we can protect the nation's soil resources and increase its productivity.

We believe that the agricultural problems of this generation, and of future generations for that matter, will be solved not so much by legislation, but more through the operations of natural physical and economic laws. Nature and economics will regulate the national or world crop production better than man can do by legislation or by organized agreement. We believe that the economic laws of supply and demand, of diminishing returns, of marginal land and marginal farmers are inexorable in their operation, and that we will be punished mercilessly when we tamper with their operation.

We believe heartily in cooperative organization for efficient and orderly marketing in harmony with economic laws that are well established though often not clearly recognized or properly evaluated.

We believe most heartily in the wisdom of each farmer adopting a well balanced production plan which is fitted to his land, his climate, and his personal tastes, and then following that plan consistently and persistently in spite of annual variations in the market price of his products.

We believe that, in a larger measure or degree than by any other method, our national agricultural problem or crisis—if you prefer that much abused word — will be solved by each individual farmer solving his own individual problems. The chief profit factor which is within the control of the individual farmer is that of his unit production cost. His consistent aim should be to lower his cost of producing each bushel, pound, or ton of his product, even though this should require an increase in his acre costs. Then his margin of unit profit is high regardless of what the unit market price may be.

There are two well recognized methods of lowering production costs. One is to reduce acre costs. The other is to increase acre yields. In general, the safest, surest and most profitable of these two methods is to increase acre yields. This is because much of the acre cost is made up of inflexible elements, so that the acre cost is reasonably consistent regardless of whether the yield is small or great. When we increase the acre yield, we not only increase the unit margin of profit, but we also have more units to sell at this higher unit profit. Also, when we increase acre yields, we often actually decrease acre costs to a certain extent.

Acre yields may be increased in any one or all of three major ways: The use of more productive seed, improving the methods of field management, and increasing the productivity of the soil on which the crop is grown. This latter method is primarily a problem in land reclamation by drainage, by irrigation, by terracing, or by substituting a more productive soil for one that is low in productivity.

Land reclamation, in its broadest sense, has blazed the trail, prepared the way, and laid the foundation for the other divisions of this society. The Land Reclamation Division of this society will continue to function in pioneering and promoting for you.

Each new farming section opened up has done far more than add to the nation's supply of food. It has increased the market for manufactured goods. The value of incoming freight and goods shipped into a new farming community will average in value very close to the value of the outgoing farm products. Chief among these imported goods, especially in new farming regions are farm machinery, building materials, and equipment.

The same thing happens when land reclamationists function in an established farming region. We make it possible to increase the profit of farming in such a section. That automatically increases its purchasing power and its consumption of manufactured goods, including farm implements and machinery, building materials and equipment.

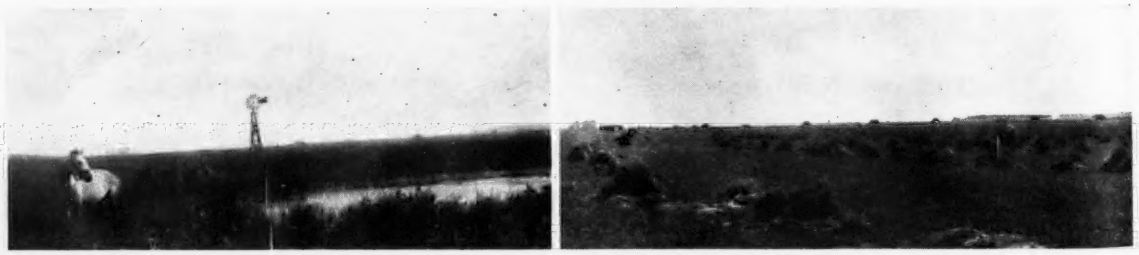
But that is not all this division has done and is doing. The tractor and power implement industries owe to reclamationists a greater debt of gratitude than most people realize. We demonstrated beyond cavil or quibble that farming with tractors was not feasible unless the land was well drained, either naturally or artificially. Much of our time during the past 20 years has been spent preaching the gospel of drainage to increase the return obtained from the work expended on the land and to make possible the use of tractors and tractor-drawn implements which have increased so vastly the amount of field work that could be accomplished by one man. The marvelous development of today in power farming equipment and methods would never have been possible without the work done by the men who make up the Land Reclamation Division of this society in making the farm lands of the nation fit and possible to be cultivated by tractor-drawn implements.

These land reclamation problems to which I referred a moment ago manifest themselves in four principal forms. Perhaps it would be better to list these in the same historical order in which they have participated in our agricultural development.

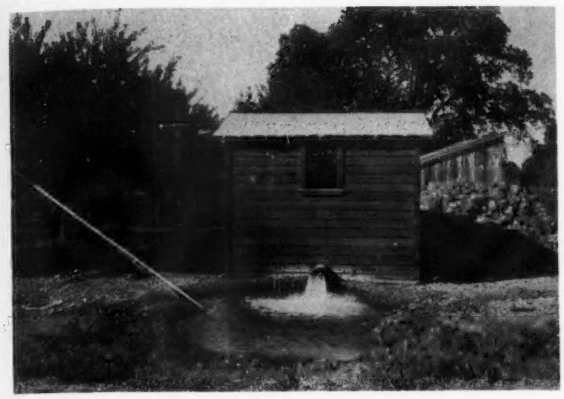
First is the opening up of large areas of new and unused lands. It was this phase of land reclamation which brought the first white settlers to American shores. It carried them westward in ever recurring waves of colonization, across the mountain barriers into the valley of the Ohio, then into the Mississippi Valley, and out on to the great plains, under the stimulus of cheap land and later the Homestead Law. This same phase of land reclamation is responsible for the development of irrigation projects in the practically unoccupied valleys of the inter-mountain and the Pacific Coast regions, the drainage of large swamp areas, and the clearing of extensive cut-over lands.

The second phase has been to replace the marginal lands of a farm or of a community with other lands that have not been cropped before because of some handicap, and thus to round out a farming unit into a well balanced efficient whole, or to supplement and increase the local capacity to produce food.

The third phase has been to maintain the lands that were under cultivation at a maximum degree of profitable production by controlling the action and the movement of the soil and water of those lands, the factors of crop pro-



(Left) A 20-acre marsh near Utica, South Dakota. (Right) This crop of oats grown on the same ground after drainage, three years later, yielded sixty bushels per acre



Agricultural engineers have mastered the handling of free water in irrigation and drainage and are making progress in studying the hydrostatics and hydrodynamics of water in soil

duction which are most thoroughly under the control of man.

The fourth and latest historical phase is to restore to profitable production those lands that have become unprofitable through abuse or neglect.

LAND CLEARING

In general, the first white settlers on American shores established their homes and farms in forested regions. They carved these homes and farms out of those primeval forests. The first trees felled were used in building their houses and barns and to serve as fuel. Beyond their own needs, they had no use for wood. When they no longer needed logs for buildings, for fences, or fuel, but did need more land for cropping, these first settlers cut the trees and burned them to make room for crops.

Just 100 years ago, my Scotch grandfather and grandmother came to the new world and settled in the forested region of Ontario—then known as "Canada West." Here they carved a little farm out of dense forests with the unremitting labor of strong hands driven relentlessly by brave hearts and the primal urge to provide for their babies. The towering trees were cut and trimmed by hand. There was then no local market for logs or lumber. So the logs were piled into great ricks by human power aided by slow moving but patient oxen. The brush and trees were burned to make room for crops that were planted, tilled and garnered by hand. The ashes from these huge fires were collected and leached to produce "black salts." By the tedious transportation of ox carts these "black salts" were hauled annually to a tiny city 40 miles away and sold for a meager sum used to pay taxes and buy those few absolute essentials which they could not make with their own hands.

The soil between the stumps was turned by hand with spade and mattock, and crops were hand planted among the stumps. Gradually, through the years, these great stumps were removed by burning or by grubbing out with spade, axe, mattock, and pry-bar. When my father left his boyhood home as a grown man, some of those original stumps still stood in the first fields of that farm. The present generation cannot conceive with what back-breaking, heart-rending toil and infinite patience and perseverance our forefathers slowly but lovingly carved their little farms from the vast forests which once covered most of the territory lying east of the Father of Waters.

For generations our forefathers were forest farmers. Slowly the nation developed and towns and cities gradually grew up among their farms. Gradually there came to be a market for the logs which had to be cut to clear the land for the plow so more food could be grown to feed the increasing population. Finally lumbering became a business, and trees were cut simply for the logs they would furnish, rather than to make room for crops.

In time, the lumbering companies found themselves in possession of vast areas of cut-over land which could earn them little or nothing in those days before industries had been developed to utilize the by-products of the lumbering operations. Taxes were being levied against these idle, cut-over lands. They became a burden and an expense rather than a source of income. There was little or no inducement to reforest them so long as large areas of virgin timber could still be had accessible to transportation and markets, and reforestation would require a generation or more before another crop of timber could be harvested.

It is only natural that the lumbering companies welcomed those who hungered for land at a low first cost. They even went out and invited them in as individuals and in colonizing groups. Naturally, also, the states in which these waste areas were located welcomed the coming of settlers into them, for settlers bring civilization and state revenues.

Slowly, haltingly, but persistently, settlements have grown in these cut-over areas of the lake states, the Pacific Northwest, and the yellow pine and hardwood regions of the South. Against heavy odds, through unremitting toil and hardships, civilization is being carved out of chaos. And still the settler follows the axeman—lured by land at a low first cost, undaunted by the labor required to make good farm land out of what the axe-man has left.

The task of the engineer has always been to lighten the labor of his fellowmen—to devise easier ways of accomplishing laborious tasks—to apply mechanical power and harness the forces of nature to do the things which through centuries have measured the muscle of man. So what should be more natural than that the agricultural engineer should undertake the task of lightening the laborious loads of land clearing?

Mechanical stump pullers had already been devised — simple devices of ratchet and lever operated by hand — cables winding on drums turned by teams. The engineers' urge to organize things resulted in the development of behemoths of steam and gasoline which pulled great trees out by their roots and tossed them onto piles for burning as though they were mere tooth picks. But, in general, these proved impractical. Most individual farm owners in these stump lands were too poor to hire one of these machines, let alone to own one. Their scarcity of capital had forced them to buy stump land because of its low first cost. That same scarcity of capital forced them to do the needed clearing with their own labor and that of their work animals.

Engineers then developed the method of removing stumps by blasting. They found it feasible in spite of the fact that available explosives were compounded to break solid substances, such as stone, instead of the softer timber and soil. So, next, they set themselves to the task of developing formulae for explosives which were better adapted to the specialized problem of blowing out stumps, which were less dangerous to handle, more effective in execution and less costly to use. They also studied the problems of how to load at different seasons of the year, for size, condition, and kind of stumps, and for different types and conditions of soil.

Thus the engineer and the chemist, working together, have taken much of the labor out of land clearing, and at a cost within the reach of many owners of stump land. But many are still forced by necessity to use the old-fashioned, back-breaking, hand labor methods of our forefathers. For these the engineers and the specialists in farm management have devised the method known as delayed or progressive land clearing. The land is used for pasture until the perishable stumps have decayed. So far as possible, the more durable kinds are burned, and the others are finally blasted out when necessary to get the land under the plow.

Water Control Progress in Florida[1]

By Forrest D. Banning[2]

FLORIDA, the Everglades State, has been exploited as a source of great potential wealth due to the fertility of its soils and the gentle winter climate that makes possible the production of many types of fruits and vegetables during a period of agricultural inactivity throughout the greater portion of the United States and Canada.

Exhaustive study of the various soil types and meteorological data available for this region show us that this great area must come under the influence of a highly developed water control system before satisfactory living conditions can be maintained, so as to permit colonization.

Records of the past forty years show that nature's balance has been much disturbed. The average rainfall from November 1 to May 1 has been 15.6 inches, while from May 1 to November 1 it is 44.3 inches. This rainfall distribution makes it necessary to provide irrigation during the winter growing season and generous drainage facilities for the rainy season. Furthermore, all available records indicate the occurrence of frost at least once during each winter season. Water is a valuable aid in combatting the ravages of frost.

The major water control system, by reason of the magnitude of the project, must be carried forward by the state and federal governments individually or jointly. This water control should be designed to provide outlets for flood waters during the rainy season, but locks and storage capacity must be sufficient to allow the South Florida farmer to obtain large volumes of water for irrigation and frost protection during the growing season.

A portion of this control system has been made available through the Everglades Drainage District and numerous smaller sub-drainage districts. The control of Lake Okeechobee must be adequate to prevent recurrence of the disasters of 1926 and 1928.

But the farmer must provide his own local water control installation if he expects to put South Florida farming on a safe basis. Water control is just as necessary to continued success in South Florida farming as cash registers, computing scales and other modern business machines are to the successful merchant or business organization in the cities.

Surface Irrigation and Drainage. The flooding or open-ditch method is in common usage in the low, flat lands, since there is an everpresent supply of water that can be had at a minimum expense by installing large-capacity, low-lift pumps and allowing the water to flow through open ditches to the fields where it is needed. Another valuable consideration favoring this type of water control is the fact that the ditches provide an excellent means of removing excess water during times of heavy rainfall. Its main disadvantage is inability to accurately control the water table in the soil.

The "Mole" System of Water Control. With this thought in mind Florida engineers delved back through the experiences of the past and decided to experiment with the "Mole Method" of sub-irrigation that had been used to some extent many years ago on the Disston Sugar Plantation in the Kissimmee Valley. The equipment used at that time was of a rather crude nature, but the only changes necessary to make it satisfactory were the application of modern track-type treads and improvement of the mole design. A powerful tractor was utilized to pull the mole through the relatively soft muck and peat soils at depths varying from 18 to 42 inches below the soil surface. Experiments were made, using various spacings, to determine the drainage, irrigation and aeration influences when these mole drains were either used for drainage or sub-irrigation, as compared with clay or concrete tiles. After three years of observations of their operation they have been pronounced satisfactory to such an extent that the largest sugar cane plantation in Florida has adopted this method for use on approximately twenty thousand acres.

The usual spacing of the moles is fifty feet and lateral ditches that connect with the main supply and collection canals are cut at intervals of one quarter mile. Thus large-volume, low-head pumps are able to maintain the very accurate control of the water table necessary to the profitable growing of sugar cane and many other crops.

Occasional frosts in some of the farming areas of the southern part of the state have led to considerable experimentation toward solving the problem of frost protection.

Open Surface Method. The water temperatures in the canals over the past five years have never gone below 59 F, according to our records. Pumping this warm water into the small ditches causes radiation losses from the soil to decrease due to the water vapor formed, which returns heat to the surface layers of air. The larger amount of water vapor in the atmosphere above several test fields has shown a marked influence on the rate of fall in temperature. A generally accepted principle of thermo-dynamics is that when there is considerable moisture present the temperature of any exposed object will fall slowly after sunset until it reaches the dew point. Since the dew point in the latitude of South Florida is usually relatively high, this factor has a great influence on slowing down the fall in temperature during the night through the liberation of latent heat by the formation of dew or frost. When the dew point is high, the latent heat given off in the formation of dew is often sufficient to check the temperature drop for an hour or more at a time. It must be remembered that excess water should be removed from the soil as quickly as possible after frost danger has passed, as the moisture laden condition of the soil has been known to cause considerable damage in retarding the growth of the plant so protected from frost. The lag in temperature drop has been sufficient in many cases to save potatoes, beans and other highly perishable crops when the indicated temperatures taken at outside points dropped as low as 26 F.

Overhead Spray Irrigation. This type of irrigation has been used generally over the United States, for many years for the purpose of supplying water to growing plants. Volumes have been written with regard to its efficiency in quickening the growing process, and to the resultant high monetary returns to the fortunate and provident grower who provided himself with its protection against periods of drought.

This protection is of definite value in Florida in many cases, but its frost-protection value has proven even greater. Many instances can be cited where beans, potatoes, tomatoes and other perishable crops have been saved by spray irrigation when indicated temperatures dropped to 20 F outside the protected areas.

Three years ago the Florida Engineering Society organized a committee to experiment on and make studies of this problem. This committee is preparing a report at this time that will take into consideration the biological as well as the thermo-dynamic angle of frost protection. It is hoped that through this committee's work a definite advance in the science of agricultural engineering will be made. This report will be made public during 1931.

Only two particular branches of water control have been discussed, but it is believed that these two phases will contribute much toward removing farming from its present gambling basis.

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[1]Paper presented at a meeting of the Southern Section of the American Society of Agricultural Engineers, Atlanta, Georgia, February 1931.

[2]Head, rural development division, Florida Power & Light Company. Mem. A.S.A.E.

Engineers' Responsibility to the State[1]

By Anson Marston[2]

THERE are two questions which require answers at the beginning of our consideration of the subject assigned to me: Who is the "engineer"? What is the "state"?

We must think of the "engineer" in three ways: First, the engineer as a man, a citizen; second, the professional engineer, a member of a great learned profession; third, the engineer's function in civilization—engineering, the most characteristic essential of modern industrial civilization.

First, the engineer is a citizen of the state. He is a picked man, a specially qualified citizen; otherwise he could not be an engineer. He must have in high degree the great basic manhood qualifications which are required for worthwhile service in any profession; honesty, loyalty, devotion, intelligence, courage, leadership, physical and mental health. In addition, he must have an engineering education of high standard and thorough training by engineering experience to qualify him to perform the special duties of an engineer. His responsibilities as a man and a citizen are not those of an ordinary man or an ordinary citizen. They are those of a specially picked and trained man and citizen.

Second, the professional responsibilities of the engineer to the state. The engineer is a member of a great and highly learned profession, a profession which is granted a special official standing by the state; and as a member of such a profession he has special responsibilities to the state. The engineer's foremost responsibility as a member of the engineering profession is for such high engineering qualifications as to be able to perform competent engineering service for his clients, public or private. In these days the state is coming more and more to certify to his qualifications by issuing him a license to practice, granting him an official standing and imposing upon him corresponding official responsibilities. The engineer has now come to be in some real sense an official representative of the state.

Third, the engineer has a special and most essential function in modern industrial civilization. The profession of engineering differs from other learned professions in that it is essential to the very existence of our modern industrial civilization, whereas the other learned professions serve only to render invaluable service. Today's great problems of civilization center around the relations of the producer and consumer. Hundreds upon hundreds of millions of the world's people are engaged in the great mechanic arts industries which produce all the physical essentials of modern life, and render services indispensable to communication and to our business and social intercourse with our fellow men. Mechanic arts products and services are even essential to modern intellectual development and artistic expression and they contribute to our spiritual requirements. Engineering is the professional phase of mechanic arts. The engineer is the professional member of our great industrial classes, without whom our modern industrial processes could not carry on. Our problems of production and distribution, surplus and deficiency, prosperity and depression, employment and idleness, standards of living and equity between capital and labor, all are related vitally to the work of the modern engineer.

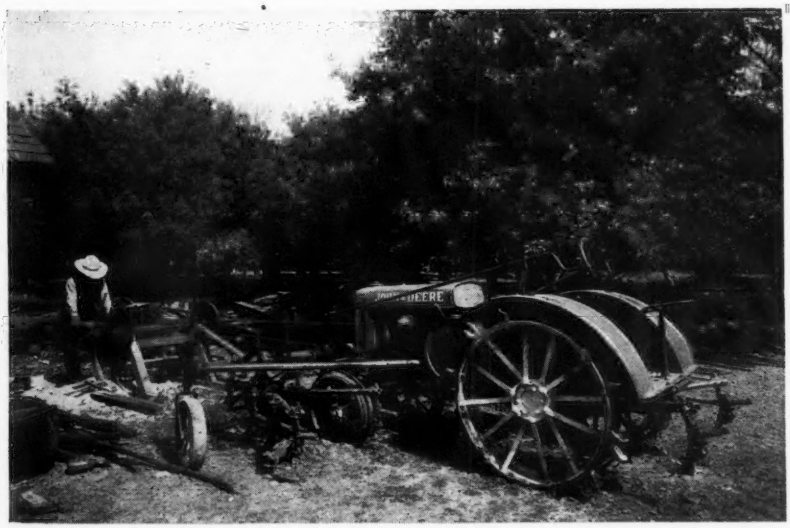
In considering the engineer's responsibility to the state, we must think of the engineer in the three ways just enumerated. We must think also of the state in three ways.

What is "state"? First, there are our official states, our governments administered by officials and employees, administrative, legislative and judicial, elected or appointed or employed. Second, our geographic states, our counties, municipalities, "states" and countries. Third, the modern industrial state, a personification of the joint lives, thoughts, and efforts of all our people.

First, the official states are our governments, administered by officials and employees, administrative, legislative and judicial, elected or appointed or employed. At the time of Louis XIV he could say with plausibility "L'Etat — C'est moi", for the ultimate authority of the government of France was vested almost entirely in its

[1]Paper presented at the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Dean of engineering, Iowa State College. Also member of the Nicaraguan Canal Commission, representative (A S C E) on American Engineering Council, past-president of the American Society of Civil Engineers, past-president of the Society for the Promotion of Engineering Education, and past-president of the Land Grant College Association.



In every part of our country there must be a well rounded development, in which agriculture and mechanic arts develop side by side to the fullest degree wisely practicable, supporting each other instead of antagonizing each other. Here is where the agricultural engineer has a great part to play in solving some of America's most vital problems

king. This was not true of Great Britain, where the people even then were gaining supremacy. More and more since 1600, the essentials of government have passed into the hands of the peoples of the different countries; and as government "by the people and for the people" has developed, the services of engineer officials and employees have been found to be increasingly necessary in carrying on governmental activities. Now even the presidents of great countries like the United States and France are sometimes selected from the ranks of engineers.

Second, the geographical states are our counties, municipalities, "states", and countries. The industrial development of each one of these geographical states is vitally dependent upon the services of the engineer, and every engineer owes to the community in which he lives some real local enthusiasm of the kind which is expressed in the old poem beginning with the lines,

"Lives there the man with soul so dead,
Who never to himself has said
This is my own, my native land?"

Third, in connection with the problems of our modern industrial civilization, we have to think more and more of what may be called the industrial state, a personification of the coordinated lives, ideals and efforts of all the people, and having somewhat the same relation to individuals which the great modern business corporation has to its stockholders. In modern industrial civilization, it is truer than ever before that no man lives to himself alone. Every individual is vitally dependent upon the services of numberless other individuals, and the efforts of all must be coordinated in such a way that each individual may have the maximum of the essentials of life, retain the maximum degree of individual liberty, and at the same time render the maximum service for the common benefit. In this personified industrial state, the engineer has most essential and indispensable functions to perform.

The engineer as a man and a citizen has special responsibilities to his official state, to his geographical state, and to the modern industrial state of which every living individual is a constituent part.

First, the engineer-citizen has the same responsibilities to his official government as every other citizen, but in greater and more binding degree, because he is a picked man, and a specially qualified citizen. It is his duty to render true and patriotic service to his government in time of peace and in time of war, remembering that governments have prior claims upon even the lives of their citizens in times of public need. The engineer is obligated to take more than the average part in public life, more than the average interest in public affairs. It is his duty to take part in politics, to vote at elections, to strive to promote liberty, equality, obedience to the laws, justice for every person. The real object of governments is to secure equal justice and the greatest practicable degree of personal liberty for all citizens. The engineer-citizen who connives in any way at corruption or injustice in governmental life is a traitor.

The engineer will never be primarily a politician, but always primarily an engineer. This does not preclude his election or appointment at times to governmental offices, even including the highest; and when circumstances make his service in public office a real duty he must not hesitate to offer himself in such capacity. The engineer will be found frequently serving upon school boards, upon city councils, and in various minor official capacities and increasingly often as mayor of a city, or as governor of a state, or as president of a country.

Second, the engineer-citizen has special obligations and responsibilities to the geographical states in which he resides. Our modern civilization is for all mankind and its achievement is the sum of the achievements of the various geographical divisions of mankind, and will reach its maximum only when every community reaches its maximum. The achievement of the individual community depends upon the enthusiastic service of the residents of the community, including its engineers. Local service and local pride are not inconsistent with but are essential to world service and world patriotism. There is always something vitally wrong with the engineer who habitually grouches and criticizes the community in which he resides, or who is unwilling to make personal sacrifices in order to serve it.

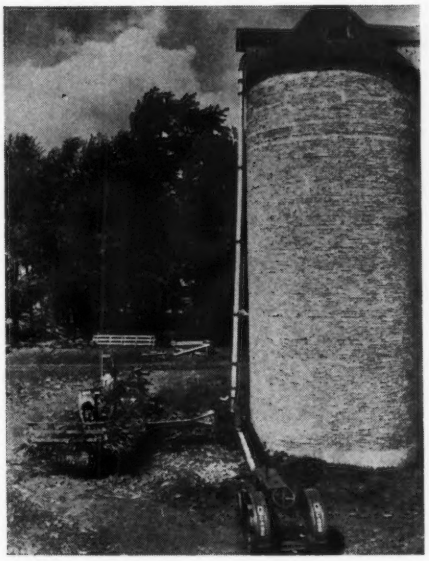
Third, the engineer-citizen is an individual member of what is here termed the modern industrial state. Every citizen is a stockholder in this state, having a personal interest in its success. This is never so apparent as in times of business depression like the present. Every hungry person, every man out of employment is a responsibility of the joint enterprise, an indication of its partial failure. We must and we will find the means to greatly reduce the number of the unfortunate and to make them productive members of society, not mere objects of its charity. We must and we will eliminate all distinction between the fortunate and the unfortunate which is due either to unjust privilege for some or to lack of widest opportunity for all. In solving these problems of modern civilization the engineer should be among the leaders, for from those to whom much is given, much is required.

The engineer is not merely an individual man and an individual citizen of a state, but a member of a great learned profession; and he has special professional obligations to the state.

First, the government—the official state— requires professional engineering service in many of its functions and undertakings. The modern municipality could not exist without the constant service of competent engineers in the most vital processes of its development and life. Its health is dependent on water supply and sewerage and garbage disposal, its daily business can be transacted only by the aid of adequate transportation, paved streets, adequate home and business structures, power, heat, light, telephone and other communications. Every municipality is constantly encountering new engineering problems. The professional engineers of each community must do more than merely render professional service to their clients. They must help to educate the community to understand engineering problems and adopt sound engineering policies. The engineers of each community must be organized to work together to render service unitedly as well as individually. What has been said of the municipality is true no less of the county government, of the state government, of the national government. Many of our greatest national problems at the present time are characteristically engineering. Our whole system of modern transportation is being revolutionized. For the first time it seems possible that transportation on highways, on railways, on waterways, on the oceans, and in the air may be organized to render coordinated instead of antagonistic service. And all this professional engineering service must be true and loyal service. As professional men, engineers are bound by standards of professional honor and devotion more strict than the moral codes. It is the duty of professional engineers not merely to render true service of their own but to punish untrue service by other engineers.

Second, to attain the maximum achievement by mankind the development of each individual geographical community and state must be as complete and well balanced as practicable. For example, we will not solve our great economic problems in the United States by any means which restricts one part of our country to agriculture and another to manufacturing. In every part of our country there must be a well rounded development, in which agriculture and mechanic arts develop side by side to the fullest degree wisely practicable, supporting each other instead of antagonizing each other. Those who preach the existence of an unavoidable conflict between agriculture and mechanic arts industries are false prophets and false teachers, albeit some of them disgrace the profession of engineering. Here is where the agricultural engineer has a great part to play in solving some of America's most vital problems. Our country has just been spending money by the hundreds of millions in trying to benefit the condition of agriculture. Admitting that I may not be an impartial observer, I do not hesitate to say that I believe that very

probably the one and one-fourth million dollars per year asked for in the engineering experiment station bill which was supported in the last Congress so actively by the American Society of Agricultural Engineers would have helped more toward a real solution of the fundamental problems of agriculture and the mechanic arts in this country than the hundreds of millions of dollars appropriated so generously by Congress for speculation in the world's markets. The great problem of successful agriculture is not to secure a certain price per bushel for wheat or a certain price per pound for cotton, but such a fair profit in the production of wheat and of cotton as will enable their producers to maintain the same high standards of living which should prevail for all people in the country. It is worth just as much to the farmer to save in the cost of production, of transportation, and of marketing as to secure an increase in price. It is worth more to the farmer to develop increased home markets for his products than to find a means of dumping surpluses on foreign markets. It is to the engineer that we must look for such reductions in the costs of producing, transporting and marketing farm products and such increases in home markets by the expansion of well-balanced industrial development in every state as to make agriculture profitable.



The great problem of successful agriculture is not to secure a certain price per bushel or per pound, but a profit which will maintain a high standard of living

I have always believed strongly in agricultural engineering and, in fact, in the vital necessity for utilizing all branches of engineering in solving our great problems of rural life. Think of what modern highways, the telephone, the radio, and the distribution of electric power in rural communities are doing and can do for the education of the children of farmers, for the participation of farmers in all the activities of modern life, for the improvement of rural home conditions, and, in general, for putting the life of the farmer in every way upon the same plane as that of other classes in our population.

The work of the engineer is essential in the development of the manufacturing and other mechanic arts industries of each municipality and state, and the well-balanced industrial development of every community is essential to the correct solution of all our industrial problems, including those of agriculture.

Third, the responsibility of the professional engineer to the modern industrial state. An industrial survey of the United States has shown that the country needs more than double the number of professional engineers now available and more than double the present annual production of engineering graduates. My definition of engineering is that it is the professional phase of mechanic arts work. The mechanic arts are those which are characterized by applications of the science of mechanics and they include all the great manufacturing, transportation, power, communication, and mining industries of the country. Hundreds of millions of the world's people are engaged in these great mechanic arts industries. They are of all degrees of training and skill, from the unskilled laborer up to the professional engineer. The services of the professional engineer are indispensable in the development of every one of these great mechanic arts industries. The engineer himself is a member of the mechanic arts industrial classes, brother to the laborer. No matter what the industrial system of the particular country the services of the professional engineer are indispensable, no less in Russia than in the United States. That country which is not educating and training an adequate body of native engineers is backward and unfortunate.

It is proper to enlarge in this address upon the vital importance of engineering in solving the great problems of agriculture, but we must not omit to remember that the problems of other industries are equally important and that their real solutions are no less dependent upon the engineer. In modern industry the engineer is now in process of taking over in large degree the executive responsibilities formerly reserved to non-technical business leaders, and more and more in the future the industrial executive must serve as the trustee of great numbers of individual stockholders rather than as the private agent of the big capitalist. Now and in the future the engineer must render much broader and more important professional service than mere technical skill, and must assume leadership in those industrial readjustments and advances without which our whole present industrial system may crash in revolution.

We have discussed the citizen-engineer's responsibility to the state and the professional engineer's responsibility to the state. We have now to consider the engineer's function in civilization. Engineering is a great learned profession, but it is much more than this. It is an indispensable factor of our modern industrial civilization, which could not exist without it. Law and medicine render invaluable and indispensable services to civilization, but they are not so essentially characteristic of industrial civilization as is engineering.

Throughout all history, the state of development of our mechanic arts has characterized the civilizations of different historical epochs. The invention and use of rude tools first distinguished man from the brute. While his tools and implements were few and crude, man remained in the savage cultural state. With his conquest of metals, accompanied by corresponding development in other mechanic arts, he attained the barbarian culture stage; and first could be called civilized when iron had generally taken the place of bronze, structures the place of huts, and land and ocean transportation and communication the place of the human carrier and the canoe. Our present modern industrial civilization may almost be said to have dated from the modern industrial revolution in the latter half of the eighteenth century, when steam power first became important in the world's work. Within the lives of those still living, the telegraph, the telephone, and the radio have revolutionized modern communication and the exchange of thoughts throughout the world. Conquest of the air is just beginning. The development of modern engineering has proceeded for nearly two hundred years at an ever accelerating rate.

In all of this mechanic arts progress, engineering, the professional phase of mechanic arts work, has been an absolutely essential factor and is still to a degree greater than ever before. The responsibilities of the engineer to the state are not alone those of a citizen, nor are they even restricted to those of a member of a great profession. They are those of men engaged in a calling whose function is indispensable to modern civilization.

There was never a time when this was quite so clearly apparent as just now. The accelerating development of industrial civilization has brought upon us a host of problems whose solution is most difficult. Engineering has had a most essential relation to prosperity. Does it have a corresponding relation to depression?

Industrial civilization has been directed to the ever increasing production of ever increasing commodities and services at ever decreasing cost. What are we to do with the surplus? Can there be said to be a real surplus when

part of the people of the world are unable to supply their wants although another part of the people of the world are possessed of more commodities than they can sell at a profit?

Machines have taken the place of human labor to a degree formerly unbelievable but as yet far less than that which seems certain in the comparatively near future. What is to be the final outcome when most of the work of the world is done by machines? How will mankind occupy its time when its working week, already only two-thirds what it was in my boyhood, is perhaps reduced to less than half what it is now? During the transition period through which we are now passing, when new machines are ever depriving new masses of men of their life jobs, what is the remedy for the resulting economic unemployment? Suppose that the use of machines should increase until an hour's labor a day by every person would supply all the human labor needed in the world? Is such a situation compatible with the payment of such wages to labor as will give it a proportionate share of the world's goods as great or greater than now?

Historians tell us that the civilization of ancient Greece was in some important respects the greatest the world has ever seen, and that this was possible only because manual work was relegated to slaves to such a degree that the Athenian citizen had ample time to devote to politics, art, literature, philosophy, science and recreation. When our manual work is relegated mainly to mechanical servitors may we hope for a civilization which will surpass that of classical Greece in art, literature and philosophy as much as our present industrial civilization surpasses the ancients in science and industry?

We do not work merely for the sake of working but for the sake of achieving results. If we can achieve a living of sufficiently high standard by one hour's work per day instead of by the ten or twelve required when I was a boy, so much the better, and the wages for labor should then still be at least as great a proportionate share of industry's income as now.

The history of Greece should warn us that the millenium will not arrive with the advent of leisure for all to devote to politics, art, literature, science, philosophy and recreation, but at least our country churchyards and our potter's fields will not need then to be cluttered with the graves of the "mute inglorious Miltons" and the "village Hampdens" of Gray's great elegy.

The engineer need not wait till some indefinite future time before turning his attention to art, philosophy and religion as well as to science and technology.

Until now there has been comparatively little relation between engineering and art. I believe that the time has now arrived for a very close relation between engineering and art, so close that appreciation of art and training in the application principles of art in engineering design should be an important part of engineering education. A course in the application of artistic principles of design has been introduced at the Iowa State College and is open to all engineering seniors. The most objectionable of the engineering crimes of the past and present are the ugly designs for engineering structures, machines, and vehicles which have prevailed. Our landscapes even have been disfigured by lack of attention to the artistic design of our roadsides and the treatment of the rights of way of our railways.

We already have courses in citizenship in our engineering curricula at Iowa State College and are trying out some brief optional courses in the appreciation of literature and the appreciation of music. The engineer of the future as well as all of the people of the future must be trained and developed to have proper appreciation of politics, economics, philosophy, literature, art, music and religion; in short, all of the things which go to make up worthwhile lives, not merely the things which are required to earn livelihoods.

I am firmly of the belief that the engineer of the world can and will take most active part in solving the great problems of industrial civilization which are now before us, and whose solution is essential to the progress of civilization.

Management and Future Business Development[1]

THE scope of management in our future business development seems to be boundless. It seems, in fact, to compass all that may be regarded as the hope for the future stability of business—not just high-profit producing, but a real, solid, stable and permanent business structure.

The management which will contribute to our future business development must be of the type which furnishes true leadership. It must be of the type which submerges individuality in the building of a broad managerial spirit throughout the entire organization. It must be of the type which instils a sense of responsibility into every key man in the organization, thereby taking into the so-called management function every individual who has under his control subordinates who must perform creditably.

* * * *

The management of each individual company has a very important job on its hands in the tuning up of its organization to produce the maximum results for the minimum cost.

To illustrate, and to bring out a few points on this important subject of broadening and perfecting management, let us consider four of the main functions of doing business, namely,

1. Engineering (design and product)
2. Manufacturing
3. Selling, and
4. Accounting.

To keep any place at all in its field a company must maintain a line of products thoroughly up to date, and at a reasonable price. It is at this point where the engineer comes most prominently into the picture.

Three things enter into this function of "engineering" the products of a company:

1. The products must be adequate to fulfil the requirements of the sales department for maintaining a proper sales volume from the standpoint of design and effectiveness.

2. The products—acceptable to the customers from a design standpoint—must be so designed that they may be manufactured at a cost which will permit their sale—and the wider the margin of profit the better.

3. The products must be backed up by the engineers themselves in the field when occasion demands.

Management in its best and most effective form requires, therefore, that the engineering function be tied very closely with sales and manufacturing. Engineers deeply engrossed in pure research have their invaluable function when a company is large enough to maintain such research or when an industry as a whole may so do. But in our future development, that portion of the engineering profession which is responsible for what has just been described must broaden its mental scope to include a vision of field requirements of a practical nature, manufacturing requirements whereby products may be produced at a cost to permit both the securing of business and the making of a profit, and accounting requirements whereby the engineer may have a fuller understanding of what everything means as expressed in figures.

[1]From "The Scope of Management in Our Future Business Development," by J. P. Jordan. "Mechanical Engineering" Vol. 53, No. 8 (August 1931).

Engineering Educational Standards[1]

By L. W. Wallace[2]

THE American Society of Agricultural Engineers is this year observing its twenty-fifth anniversary. These twenty-five years have been momentous ones both for agriculture and for engineering. Each has experienced the ups and downs of the period. While it is not my purpose to review the agricultural and engineering events of the past twenty-five years, I will refer to a few pertinent facts.

Prior to 1904 no technical institution of higher learning offered a course in agricultural engineering. Today, thirty-five reputable institutions confer a bachelor's degree or its equivalent, in agricultural engineering. This is a significant advance, for which the American Society of Agricultural Engineers deserves a large measure of credit.

On July 1, 1931, there is to be established by the Federal Government a Bureau of Agricultural Engineering. This recognition of your specialty by the highest authority of the land establishes another important benchmark on your roadway of progress. You have a just right to be proud of this fact. You were responsible for this because of your accomplishments.

In this advance of agricultural engineering, American Engineering Council has been interested and gratified. We constantly do what we can to advance the well-being of your branch of the engineering profession.

The facts to which I have alluded set new metes and bounds for agricultural engineers. They clearly indicate new and broader opportunities which also carry in their train added responsibilities. You have in the past readily grasped the opportunities, even more, you have created them; you have fully met your responsibilities. As the record of the past is a good criterion of the future, we may and do confidently look forward knowing that you will not permit either an opportunity or a responsibility to escape. Please remember as you travel the pathway that destiny has carved for you, you have the earnest good will and support of American Engineering Council.

Authorities have failed to formulate many definite and specific standards in engineering education. A little reflection leads me to conclude that this is fortunate for the engineering students. All students are not fashioned alike; they were not cast in the same mold. Why then should each be put through the same mill. The purpose of education is not to manufacture tin-lizzies but to build men—men who can think—men who can creatively use their faculties amidst the usual and unusual circumstances of life.

The authorities have, however, listed some nine standard points[3]. These I shall give you with some comment. They are:

1. Since engineering is concerned with technological, economic and administrative problems, it has an immensely ramified scheme of individual specialization along both technical and functional lines, and it is impracticable to reproduce this complex pattern in a workable scheme of formal education.

It is self-evident that engineering must be concerned with technological problems. And again would anyone at all well informed question for a minute the proposition that economics should be one of the fundamental courses of study of the embryonic engineer? The pity is that a lot of the older ones did not have more of it and have not continued to study economics since graduation. Had they done so, many of our industries would not be so over-equipped and there would not have been such a disastrous stock market slump in 1929. Any neglect of a thorough training in economics in the future will indicate that engineering education has failed badly. And I would say the same of psychology and government. These things must come because the battle front of the engineer of the future will be not only controlling and utilizing the forces of nature, but also combatting all impediments to the advancement of the social, political and spiritual well-being of the human race.

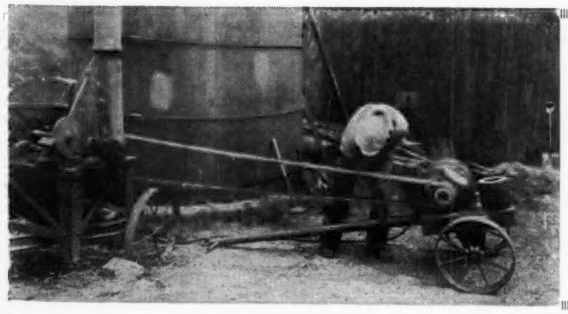
2. Technical schools should concern themselves with underlying fundamental principles but these principles are best taught by practical applications; therefore technical subjects should serve as the media for teaching the principles.

This is another Jonah as far as my intellect is concerned. My surmise as to the idea implied is that engineering education should bear down hard on such fundamental subjects as mathematics, physics, chemistry and mechanics. To this I subscribe, with these additions: English, economics, psychology, a liberal sprinkling of the amenities of life, and good manners. I say this because the engineer of the future will have to be a highly cultured, social and human individual if he is to make a material impress upon the world of affairs.

It is my further thought that far too much time is spent upon the so-called practical applications. I refer to shop, drawing room and laboratory exercises. Much time so spent could be better applied in teaching the social graces. We have more blacksmiths, lathe hands and revolution counters than we need. What both the country and the engineering profession require is more public spirited, creative leadership.

3. Engineering educational standards to-day demand a highly realistic educational philosophy — the methods of analysis, the graphic, symbolic language of the profession, illustrated through laboratory methods and taken from the student's personal experience.

Some of this is really good sense,—that is, after you pass the phrase "realistic educational philosophy." To "methods of analysis" should be added "and synthesis." No great problem is solved by merely breaking it up into its elements. The answer lies also in reassembling, which



Each institution should make a thorough study of the territory it serves and predicate its major efforts upon the needs of that territory. There is no sound reason why every technical school should teach the same engineering courses. Each institution should major on problems peculiar to its area

[1]Paper (published here in part) presented at the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Executive secretary, American Engineering Council.

[3]"Report of the Investigation of Engineering Education 1923-29," by Dr. W. E. Wickenden. Society for the Promotion of Engineering Education.

is synthesis. Time—considerable time—could be profitably spent in teaching the true process and significance of analysis and synthesis. My guess is that a great many graduates from technical institutions have no more than a mere academic, or better, sophomoric understanding of the processes of analysis and synthesis, whereas their success will largely depend upon their mastery and use of these processes.

4. The principal curricula of the different engineering courses should be differentiated from each other only to a moderate degree. In general, specialization should be postponed for the graduate school or actual practice.

In an earlier paragraph I said that education did not consist of producing tin-lizzies. Neither does it consist of making a different kind of crank out of every piece of crude material that enters college. We have gone so far in making cranks that every instructor desires to convert his subject on do-dads into a specialized course with himself as the head-master. This thing has done more to break up the solidarity of the engineering profession than any other single factor. For the majority of men it is time for them to begin to confine themselves to a speciality about ten years after graduation. It takes about that long to establish a sufficient foundation for a successful career as a specialist.

5. The engineering educational program should be built upon broad lines of humanistic, scientific and technological materials. This means a substantial course of study in English, economics, mathematics, the physical sciences and such subjects as develop the scientific attitude or approach to a problem.

I fully subscribe to this, and for fear of distracting your attention from its significance, I shall make no facetious comment.

6. Relatively few institutions should undertake to provide special training in specific fields of engineering practice, and this training should be carried on largely in post-graduate courses.

Too many institutions have been copy-cats. College A because of favorable circumstances or sound reasons develops a strong, successful course in some subject. College B at once jumps to the conclusion that it should establish such a course, and this without any rhyme or reason. A tremendous amount of good, hard money and valuable time has been wasted by this unwise practice. There is no need for every technical institution having a railway mechanical engineering laboratory or a school of mines. Nor is there any justification for an inordinate duplication of research work. It would be far better for each institution to concentrate all of its resources on a limited number of real research problems and see them through to finality.

7. The economic aspects of engineering should be given ample emphasis.

Even the authorities did not feel certain of their ground when they wrote this standard. As a matter of fact, they merely acknowledged a sort of left-hand relationship. If I were writing this standard I would say that if the engineer is not to have a broad and sound grounding in economics he had better study something else than engineering.

8. The quality of engineering education depends primarily upon the character, qualifications and effectiveness of the teachers; teachers in engineering education should have both scholarly and professional experience and should be in active touch with the engineering profession.

There can be no substitute for good teachers. Mere physical equipment does not make a good institution of learning. The pity is that so much of the income is spent for physical equipment and not a larger proportion for salaries so that the technical schools could engage more high-grade men. Under the circumstances the splendid educators we do have are deserving of the greatest credit for the financial sacrifices they have made in order to remain in the teaching profession. Agricultural engineering has been fortunate in that it has had the services of such educators as J. B. Davidson, H. B. Walker, C. E. Seitz, and others.

9. The engineering profession, through its national societies, should assume more responsibility for the programs and standards of engineering education.

To this principle I fully subscribe. The profession has woefully neglected its responsibility in this regard. It should be a competent judge, free of institutional prejudice, of what the content of an engineering course should be. The organized profession should more actively assert its prerogatives in this regard.

Having stated and commented on these general principles, I shall now tell you what I think about engineering education.

Primarily engineering courses should be designed to give a thorough grounding in mathematics, physics and chemistry. The student should have a thorough understanding of how to apply the principles of such subjects. It is my belief that a large number of graduates really do not grasp the significance of these subjects and do not know how to use them effectively. As a consequence they are not ready working tools. There has been too much superficiality in the teaching of these subjects.

Engineering courses should secondarily include a large measure of English, economics, psychology, government and personal conduct. Under personal conduct I would include personal appearance and behavior or all that is encompassed under the title of good manners. We have made a great mistake in letting the sentiment prevail in student bodies that to be a roughneck is to appear as an engineer. We should scour the rough necks, wash their ears, crease their trousers, and polish their shoes. We should send engineering graduates out equipped with social graces as are the graduates of the Naval Academy and West Point.

Far too much time is spent repeating shop, drawing room and laboratory exercises. Too much emphasis has been placed upon the so-called practical work. The engineering profession and the country need more creative, humane, and cultured leadership, not mechanicians.

I am opposed to so much specialization. Every Tom, Dick and Harry on the instructional staff constantly endeavor to make their subjects specialities. Because of this we have been getting mediocrity and not broad-gauged leadership. Also because of this the solidarity of the engineering profession is being destroyed.

Far more intensive attention should be given to imparting a thorough understanding of the methods of analysis and synthesis as such. It is not sufficient to let students obtain some understanding of these important factors merely as a by-product of their other work. There is no better way to teach logic, to train for creative thinking, and develop real leaders than through imparting a thorough understanding and appreciation of the processes of analysis and synthesis.

Each institution should make a thorough study of the territory it serves and predicate its major efforts upon the needs of that territory. There is no sound reason why every technical school should teach the same engineering courses. Each institution should major on one or more problems peculiar to its area.

There is need for a greater standardization of research programs; for less diffusion and more concentration to the end that truly significant projects may be undertaken and carried through to finality in a reasonable time.

The methods of teaching should be greatly revised and improved. I have the feeling that many modern methods of transmitting information are not being used to the extent possible and desirable. The motion picture, the radio, the x-ray, and many other scientific developments should be more largely used as aids to teaching.

Engineering teachers should be systematically taught how to teach. It is unreasonable to assume that an engineer, whether he has or has not had practical experience, can step into a class room and effectively teach thermodynamics, mechanics or any other technical subject. Yet without any special training, hundreds of men are so projected every year, with what bad results no one can

tell or dare conjecture. Everyone will at once say a man cannot be an engineer unless he knows the fundamental principles of engineering. Yet we endeavor to train engineers under teachers who have not even a smattering knowledge of how to teach. That we have such great teachers as Kimball, Cooley, Marston, and others is due to kind Providence rather than design.

More and better prepared teachers is the great need in engineering institutions. They should be prepared and obtained even though it may mean a smaller number of steam and gas engines and less spacious class rooms.

The organized engineering profession should devote a large measure of time and effort towards improving engineering education.

I have ventured to make such comments because I visualize a great future for the engineering profession, provided it prepares itself. This future has been beautifully and inspiringly expressed in these words by Loughnan Pendred[4], an eminent British engineer. "With the ideal of a new and greater service, another world to conquer lies open before the engineer. He has ministered, and will continue to minister, to the material wants of man, but something far far greater lies before him. It is not for him, perchance, in his vocation to peer into the 'soul of things,' but through him the attainment of that glorious abstraction may be made easier. He has brought men together and can bring them closer yet; he can knit the whole world into a single unit; he can remove the frontiers of the land, the sea and the air; and hasten the coming of a common tongue, a common understanding and a common will to good. With him, and him alone, rests the power to make war or preserve peace. He can decrease labor and increase leisure. He is the great educator. He can take men to see the wonders of the world abroad, he can diffuse great literature, he can bring the voices of great thinkers to the firesides of the humblest. Literature, music, art and philosophy are in his train."

The engineering profession will never rise to the heights depicted by Mr. Pendred unless it broadens its foundation. This foundation needs to be broadened in the direction of the social and cultural graces. It is my earnest wish that the engineering institutions of the world will so set their courses as to send forth from their portals men not only steeped in the fundamentals of their profession but also equipped with such a social and cultural background as to enable them to be at home in any presence, and to be recognized at once as cultured, creative leaders.

[4]Editor-in-Chief, "The Engineer," (London), in an address before the American Society of Mechanical Engineers at its fiftieth anniversary meeting, Washington, D. C., April, 1930.

Agricultural Engineering Educational Standards[1]

By H. B. Walker[2]

IT SEEMS desirable to preface my discussion of agricultural engineering educational standards by a few definitions of the terms involved. The Encyclopedia Britannica states that "engineering at the present day may be broadly defined as the practical application of science and scientific methods to industry." Accordingly, agricultural engineering for our purposes may be considered as the practical application of science and scientific methods to the industry of agriculture. Education, as defined by the Standard dictionary, is "the systematic development and cultivation of the normal powers of intellect, feeling and conduct so as to render them efficient in some particular form of living or for life in general." Professional education, on the other hand, fits the individual for his particular career or profession.

We may then think of agricultural engineering education as a preparation for a professional career, whereby the normal powers of intellect, feeling and conduct of the one who successfully completes such training have been systematically cultivated and developed to render efficient service in the practical application of science and scientific methods to the agricultural industry. The completion of a prescribed curriculum in agricultural engineering education, however, does not qualify or develop one as a professional agricultural engineer. Rather, it indicates the achievement of certain educational objectives which are recognized as necessary prerequisites to further effort in self education in this field. The success of this latter effort really establishes the engineer's standing in the profession. For this reason we should not think of agricultural engineering education itself as strictly professional, altho it may be rightfully recognized as a prerequisite to an ultimate certification in the profession.

Several years ago the Advisory Committee of the College Division outlined the aim and objective of agricultural engineering education, as follows:

> "The objective of Agricultural Engineering education is to develop leadership by encouraging higher efficiency, greater productive capacity and better operating practices among those engaged in the production of raw products for food, shelter and clothing, through the application and use of engineering principles in the industry of agriculture.
>
> "The aim of this objective is directed toward creating a desire for, and the capacity to enjoy, higher standards of living, better working conditions, adequate educational facilities and equitable social progress for those engaged in the agricultural industries."

This is a highly creditable statement and carries considerable idealism. It is pointed toward the ultimate objectives in agricultural activities and living. It emphasizes the fact that the most important objective in agricultural engineering is the welfare of those engaged in the industry, rather than the science of engineering. Agricultural engineering thus becomes incidental to the progress of agriculture and unless it contributes to the ultimate objectives of the industry it has no real justification for existence. For the purposes of this paper, however, it is necessary to discuss some of the incidental things which contribute to the welfare of agriculture. We as engineers are concerned with agricultural engineering educational standards. Accordingly, the most important word in our topic is engineering rather than agriculture, because the responsibility for engineering progress in agriculture rests primarily upon a sound conception of our duties and relationships to the industry we strive to serve. Proper preparation for this service is a primary consideration.

The Society for the Promotion of Engineering Education, in outlining the fundamental conception of the undergraduate curricula, states that[3]: "To serve its purpose adequately this undergraduate program of studies should provide a basis for the three types of activity common to all engineering, namely:

1. The control and utilization of the forces, materials and energy of nature;

[1]Paper presented at the College Division session of the 25th annual meeting of the American Society of Agricultural Engineers at Ames, Iowa, June 1931.

[2]Professor and head of the division of agricultural engineering, University of California. Mem. A.S.A.E.

[3]"Engineering Education," Vol. I (1930), Structure of Undergraduate Engineering Curricula, p. 84.

Some confusion has arisen in the past regarding major options in agricultural engineering which may be followed by students enrolled in non-engineering college courses. Men who are not trained in basic engineering subjects cannot be classed as even potential engineers while undergraduates, and these should not be permitted to undertake duties requiring technical preparation

2. The organization of human effort for these purposes; and
3. The estimation of costs and appraisal of values both economic and social, involved in these activities."

Consider for a moment just how these statements relate to agriculture. In the production of raw products for food, clothing and shelter it is apparent that we must take into account the control and utilization of the forces, materials and energy of nature. Vegetable and animal life supported by the soil are directly dependent upon these things. The energy of the sun is of primary importance in the production of raw products and it is utilized effectively for the conditioning and processing of crops. The forces and materials of nature are utilized in farming on every hand and fortunately no new fundamental engineering principles are involved but only a different ingenuity and form of effective application. Power and labor, in themselves representing the forces and energy of nature, are utilized in abundance in agricultural operations and here again the only difference is one of application to tasks rather than one of fundamental sciences.

The organization of human effort for production is a typical engineering problem common to all industries, and is ordinarily simplified in large centralized organizations by having a high degree of specialization among its workers. In agriculture this has presented a difficult management situation which has stood in the way of engineering progress. Changes in farm organization, however, are gradually taking place which are enabling engineering methods to be applied more effectively. Only time can determine how extensive these changes will become, but here again no new fundamental principles are involved.

The estimation of costs and appraisal of values, both economic and social, involved in engineering activities introduce both tangible and intangible values. Costs and values may be definitely analyzed by sound economic principles. The engineer cannot neglect economics if he functions as an engineer because he is concerned with the practical application of science and scientific methods to industry. The engineer who is concerned with production problems fails if he neglects the economic factors involved. A physicist may legitimately do this, but not an engineer.

Economics is inherent to engineering. An economist may not be an engineer but a successful engineer whether he is conscious of it or not, becomes an economist. Too often engineering is judged solely by the economic results obtained. It is the usual custom to do this. It is a tangible measure and for the most part engineers deal in tangible terms. When social factors are introduced intangible values are involved and most engineering reports do not devote much space to intangible values. However, the charge should not be made that engineering is entirely materialistic and lacking in cultural appeal.

Culture relates to human impulses which tend toward the enlightenment of civilization. A man may have a trained mind and still be lacking in cultural impulses. To say that engineering studies are lacking in cultural appeal is hardly the truth. A knowledge of physics and mechanics is necessary to design a labor-saving machine. The machine when perfected is justified in the public mind by its economic importance, yet the same machine may be the means of overcoming adult and child labor, shortening working hours and providing needed time for pleasure and self-improvement of workers. These social benefits rarely go to the credit of engineering nor do such factors bring credit to him as one who is concerned with cultural impulses. On the other hand, it must be admitted that strictly engineering subjects have less cultural appeal than many of the courses in liberal arts. For this reason a great responsibility rests upon the engineering teacher to inject the proper social and cultural aspects of engineering training into the more drab engineering courses. Furthermore, a study of the so-called cultural subjects should be encouraged among engineers.

We now come to the more direct problems connected with the standardization of an agricultural engineering curriculum. At the outset it must be understood that we as engineers are concerned primarily with the training of men to render engineering service to the industry of agriculture. The preceding discussions have tended to show that fundamentally engineering in agriculture is not unlike engineering in other industrial fields. From a practical point of view there are certain essential differences. This is due to the nature of the industry concerned. The agricultural engineer is concerned with power, labor, structures, water supply and land improvement methods used in the industry of agriculture. In addition he is concerned with the processing and conditioning of raw products such as grinding feeds, forage, dehydration of farm products, dairy manufacturing, refrigeration, etc. In all of these we are concerned with fundamental engineering problems involving the use of mathematics, chemistry, physics, mechanics, thermodynamics, hydraulics, economics and applied problems in civil, mechanical, electrical and agricul-

tural engineering. The fundamental requirements being practically identical to those in other engineering fields there appears to be no great necessity for differentiation in basic training in undergraduate engineering instruction, and possibly, there is no great justification for the establishment of separate divisions of agricultural engineering for this particular form of engineering education. So long as he is objectively minded and can visualize the problems of the industry he seeks to serve the mechanical, electrical or civil engineer may qualify for engineering service in agriculture practically as well as the trained agricultural engineer. This has been done repeatedly. On the other hand, some orientation during undergraduate training is feasible and desirable so long as this is accomplished without omitting fundamental engineering training.

In this connection agricultural engineers must recognize that the accepted four-year undergraduate period is too short to include very many applied courses. Furthermore, it is essential that there should be but little differentiation of basic subject matter during the earlier period of training because students will find that their interests change and shifting from one engineering curriculum to another should be possible without great loss in credits. This is also desirable because of the growth in junior colleges.

The degree of bachelor of science is granted to engineers in most institutions upon completion of 140 semester units of course work completed with equivalent credits. Universally required subjects for engineers, regardless of option, are about as follows[1]:

Mathematics (analytical geometry, differential and integral calculus)	12 units
Physics (mechanics, heat, magnetism, electricity, sound and light)	12 units
Chemistry (general)	10 units
Civil engineering (surveying and strength of materials)	11 units
Electrical engineering (elementary circuits and machinery)	3 units
Mechanical engineering (descriptive geometry, heat power engineering, analytic mechanics)	12 units
Allied sciences (hydraulics)	6 units
Thesis or equivalent	4 units
Total	70 units

These fundamental courses are independent of options and are essentials for a foundation in any engineering training. Curricula designed for training technical agricultural engineers leading to the bachelor's degree in engineering which are deficient in these subjects, should be revised and brought up to this standard or its equivalent if we as agricultural engineers hope to maintain the confidence and respect of the engineering teaching profession. These represent only the substructure upon which all of the various engineering curricula are constructed and agricultural engineering should be no exception.

In agricultural engineering the superstructure may be varied somewhat to meet the particular needs of the industry served. The agricultural engineer is concerned with soils, crops, processing, management, and the power and equipment involved in production. In the study of soils, geology becomes an allied science. Botany of an elementary nature is a desirable prerequisite to a study of crops. An understanding of the principles of bacteriology is helpful in animal products and crop processing. Thermodynamics, an engineering fundamental, is particularly essential for success in this field. General economics is a fundamental prerequisite to farm management and likewise necessary for a well-rounded engineering education. Time also should be allowed for free electives to provide opportunity for cultural development.

It is evident that after essential courses are cared for, there is but little room for applied subjects. Courses like stock judging and shop work should be eliminated in favor of the more basic technical subjects. Courses in farm power, machinery, structures, water supply, sanitation and processing should have a direct agricultural slant but these should have such rigid prerequisites in physics, chemistry, mathematics, mechanics, thermodynamics, hydraulics, etc., as the course may require for thoroughness and completeness. Descriptive courses should be avoided.

There is grave danger that agricultural engineers may overemphasize the practical phases of their applied work without developing the fundamental relationships to basic engineering subjects. To do this means an injustice to the student and the eventual lowering of our own standing in the engineering field. In making our standards we should hold closely to the requirements of established four-year engineering curricula with just sufficient applied work in agriculture to direct the students thought and interest to the problems of the industry. Five-year courses undoubtedly will develop in the agricultural engineering field.

A hint was made earlier in this discussion that agricultural engineering divisions may not be necessary or justified for the training of technical engineers alone. The differential in training in regular four-year agricultural engineering curricula if properly standardized, will be relatively slight as compared with mechanical engineering, and agricultural engineering might very logically be made an option of the latter.

Administrative policies in agricultural engineering have always been more or less varied because of the initial organization of the work and the institutional functions of these divisions. From a technical education standpoint only one logical policy is apparent. The training of technical agricultural engineers is a function of the colleges of engineering and such training should be administered by the deans of such colleges whether operating through independent divisions or as options in mechanical engineering. We as agricultural engineers should use our influence to standardize this practice which fortunately is now the generally accepted policy.

Some confusion has arisen in the past regarding major options in agricultural engineering which may be followed by students enrolled in non-engineering college courses. Men who are not trained in basic engineering subjects cannot be classed as even potential engineers while undergraduates, and these should not be permitted to undertake duties requiring technical preparation. This does not mean that such students shall be denied professional status through engineering achievement, but to place such training on a par with technical instruction is not in keeping with the true spirit of agricultural engineering education.

This paper has dealt primarily with technical agricultural engineering education. The organization of agricultural engineering divisions or departments for the purpose of teaching courses relating to farm production and management and for the conduct of research is justified and highly commendable. In this work the problems of administration and organization may be quite different from those of technical training. These functions for the most part are intimately related to the work of the colleges of agriculture and agricultural experiment stations and as such should be subject to their administrative and technical regulations.

SUMMARY

1. Agricultural engineering education is essentially engineering education.
2. Technical engineering education should be administered by colleges of engineering.
3. The differentiation between agricultural engineering curricula and other engineering curricula should be as slight as possible consistent with preparation for efficient service to the agricultural industry.
4. The foundation courses in all engineering curricula should be identical.
5. The term agricultural engineering when used in connection with the word education should relate only to technical training leading ultimately to a bachelor's degree in engineering.

[1]Based on requirements of the college of engineering, University of California.

An Owner's Opinion of Large-Scale Farms[1]

By James Mills, Jr.[2]

THE period through which we have been passing during the last ten years, and particularly the latter portion of this period, has been one which has seen a continuous fall of commodity prices without an accompanying fall of equal extent in the cost of carrying on farming operations. In fact at the present time farmers find themselves in a position where the farm dollar determined by the U. S. Department of Agriculture has a relative purchasing power of only 63 cents as compared with pre-war times. These conditions have been conducive to a great deal of thought on the part of all farmers, and particularly those who are operating on a large scale where all costs entering into the picture are given due cognizance. It is estimated that last year not over 5 per cent of the farmers in the state (California) made operating costs, irrespective of overhead.

If it were not true that during this period the farm tractor with its accompanying tools and other mechanical appliances for handling different farming operations had been perfected to the point where a large saving in manpower has been possible, farmers as a whole would have been in an even worse predicament than they find themselves today. During this period large, diversified properties have unquestionably fared the best as not only have they had diversification of income, but the very nature of their operations has permitted the utilization of farm equipment to the greatest efficiency. I believe that a study of the use of farm tractors alone would show that the small one-crop farmer has only been able to use his tractive equipment from 250 to 300 hours per year, while on the larger diversified farms 2500 to 3000 hours use has been quite common, and some operators keep their tractors working 5,000 to 5,500 hours a year.

Perhaps the easiest way to bring before you my thoughts is to picture to you the results of our own experience on the Mills Orchard Company properties during this period. Our properties include two units totaling 8,300 acres. One, at Hamilton City, is devoted to oranges, grapefruit, prunes, pears, peaches, apricots, almonds, olives, grain and turkeys and the other, at Maxwell, has mostly lemons, but also has liberal plantings of pears, shipping peaches, apricots, nectarines, plums, drying prunes, oranges, grapefruit, melons, alfalfa and grain crops. On each property there is a large drying plant, and a packing plant to handle the shipping fruit. At Maxwell there is also a large livestock plant for raising sheep, turkeys and hogs.

The operating personnel are organized under a packing house manager who handles the fruit shipping and a general superintendent who handles the entire cultural end of the work. Under the general superintendent there is employed on each ranch a ranch superintendent, who in turn directs his operations through foremen, each of whom has some special end of the work to carry forward. At Maxwell for instance, there is an irrigation foreman, tree maintenance foreman, tractor and cultivation foreman, sheep and field crop foreman, etc. This organization permits of the handling of each individual operation on an intensive basis. Over a period of years, inasmuch as the present operating force has been a steady one, it has enabled the men in their specialized work to develop to the point where each knows more of the work in his own department than any others in the organization. This is highly important because each individual industry within a large organization is of necessity a specialized one, and it is almost impossible for any one man to master all of the problems bearing upon every industry in a diversified undertaking.

The packing department is likewise organized so that the major operations all receive their due share of expert attention. On a large property perhaps the most difficult management problem is that of focusing the attention of the employee, with any particular work in charge, on the individual unit rather than on the acre or other subdivision. This is most important because in the last analysis the aggregate of the results obtained from the individual tree or other unit determines the ultimate results from any wholesale operation. Our organization operates with due recognition of this fact.

It is unquestionably true that on a large property where men and machinery can be moved from one operation to another many economies not possible on a smaller farm can be achieved. For example, I find that the company tractors on the average, operate about 2500 hours a year. This is a most important consideration because it enables an organization to keep operators on steady employment, and at the same time the large number of hours the machinery is used per year reduces very materially the overhead per hour allocatable to each individual tractor or other unit of equipment.

One outstanding point concerning the orchard properties is that the different crops are so balanced that to a large extent the peak load demanded by one crop blends into the next so no short extreme peaks occur. In the harvest season the harvest of one crop dovetails into that of another so that the harvest crew organized in June is almost steadily employed at the Hamilton ranch until the following January, while at Maxwell the harvest load runs from early in June right straight through until the following April. Being able to maintain a steady force makes it possible to carry employees forward at a lower daily wage than would otherwise be possible, for it stands to reason that one employed for a thirty-day job expects more per day than one who is given steady employment for a twelve-month period.

To supplement in so far as possible the daily wage, other benefits are given employees, such as dwellings at cost, groceries and other supplies at the company's stores at less than current retail prices, the benefits of group life insurance and of a hospital account. The latter takes care of ordinary ills and for many years has been maintained by the company for the benefit of its men. On large properties there is always the human element entering into the situation much more than there is on small properties. The leaders on the two properties are carried on a profit-sharing or bonus basis, which has proven most advantageous to both the company and the leaders themselves.

This brief picture of our company's set-up indicates that the arrangement of both the plantings themselves, and of the management set-up is approaching the ideal as we have pictured a diversified farm. This is certainly true from the standpoint of operating costs. It is impossible for a small operator to in any way duplicate wholesale operating costs.

Even though the above indicates one of the most profitable operating set-ups as we have in the past visualized farming, the experience gained indicates that the ultimate in profitable operation has not nearly been reached. Our future conception of proper diversified farming must differ radically from our old conception, if the ultimate from a diversified farming venture is to be obtained. Agriculture today is on such a highly competitive basis that only those crops which are situated in ideal areas from the standpoint of soil, climate and other advantages will

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[1]Paper presented at a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers, at Berkeley, California, May 1931.

[2]Vice-president, James Mills Orchard Corporation. Mem. A.S.A.E.

show satisfactory production profits. It is unquestionably true that during the past few years crops so situated and economically handled have been produced at a profit, even on current selling prices which, relatively speaking, are the lowest in some twenty years.

Today in agriculture as in all other industries we have arrived at the point where scientific facts controlling production of each individual crop are so complex that a specialist is needed to carry forward the operations involved in the production of each crop to realize the utmost obtainable from that crop. These ideas alone seriously challenge the idea of extensive diversification of crops on any one individual unit. The ideal farming venture of the future will be a grouping of several farming units producing specialty crops in several localized areas best adapted to each of the individual crops involved. Such a set-up would permit of the most intensive development of each crop and at the same time of the savings wholesale operations permit. It would also to a limited extent, depending on distance, permit of the shifting of machinery, men and other equipment from unit to unit as the work on each individual farm in the group could be made in a large measure to dovetail into that of another. This grouping of units would also give a diversity of income as to season and crop, which in turn would give the entire venture almost positive assurance of coming out at the end of the season with a fine operating profit.

I do not visualize the time when the forty and fifty-acre unit carried on by one operator growing one or two crops ideally situated for the district will be entirely replaced by wholesale farms, but unquestionably under existing conditions the ten and twenty-acre units, except in a very few industries, are gradually going to be forced out of the picture, just as the corner cobbler has gradually been replaced by the larger shoe manufacturer. Diversification, as we know it today, tends to bring about the production of some crops which are not ideally situated to the district involved. Such crops under existing competitive conditions cannot be termed other than verging on the marginal.

I can visualize in the future an extension of the present economic analyses which have been carried on by the University of California and the Giannini Foundation. Although this subject is not entirely in line with that which I have had under discussion, I feel it is so important that I would at least like to bring a few thoughts to your attention. Agricultural development in California has taken place so rapidly and development has in so many instances been fostered by real estate operators, who have not been agriculturists, that there has been a very decided tendency towards the development of crops in many districts not in any way favorably situated for such development. In addition to this there has always been the tendency on the part of our financiers to hold up financial aid within an industry that was apparently not exceedingly prosperous and to only loosen up the purse strings in boom times when apparently a great deal of easy money was dropping into the hands of those actively carrying on the industry in question. Such a procedure has certainly resulted in the banks gradually owning more and more of our California lands, for in many instances they have stepped into the picture and financed expansion in certain agricultural industries at times when very prosperous, though not economically sound conditions, prevailed. As a result of rapid expansion in the production of the crop involved, in a very few years producers of that crop found themselves in a position of having to market a surplus at very low prices and this has in turn resulted in many periods of depression within certain California agricultural industries and the gradual acquisition of the land used by banks or other institutions.

A notable example of this occurred in the rice industry in the Sacramento Valley. In 1916 and 1917 it was quite difficult for many operators to get all the money they needed to go ahead. In 1920 and 1921 when rice had pyramided from a commodity bringing $2.00 to $2.50 per 100 pounds to one bringing as high as $10.00 per 100 pounds there was no limit to the money available. In 1921 the crash came and growers who sowed $10.00 seed harvested $1.50 rice. The result was that the banks were forced to take over a large share of the property employed in rice production. The same thing occurred in grapes in the San Joaquin Valley and it is possible to cite many other instances.

I firmly believe that the time is now here when the bankers are about ready to pick up the economic analyses of each individual agricultural industry where now available and to carry it down to the point where they will be in possession of the facts surrounding each California agricultural industry. They will carry the analyses even further so that they will know beyond a question of a doubt which district and which soil within each district is best suited for the crop in question, what the world conditions in that industry might be and what stage of its production cycle the industry is then in. With all of these facts in hand it will be possible for them to largely prevent by withholding finances, the production of crops not ideally suited to each district involved and to prevent pyramiding the production of crops, which local and world conditions indicate are rapidly approaching conditions of overproduction. Likewise with such facts on hand we will see them stepping into an industry favorably situated from the standpoint of world conditions and district advantages as is the prune industry in the Colusa district at the present time, and find them confidently financing growers through the low period in the cycle in anticipation of much better times in the not too distant future.

Close cultivation under orchard trees with a small tractor and special hitch on the Mills properties

Farmers will then be able to obtain from their local bankers as much pertinent information concerning their individual crops as bankers are now able to give to men interested in buying stocks and bonds or in

erecting new city blocks in the hearts of our larger cities, etc. Inasmuch as the money to operate on is the most essential requirement for any development, whether in agriculture or elsewhere, I feel that only by our bankers wisely controlling the flow of that money can we ever to a large extent eliminate the problem of overproduction and anticipate the revival of good times in our present industries, which, by the way, are rapidly moving past the status of overproduction in their respective cycles. The future, as I see it, is the development of agriculture on a more economic as well as a wholesale basis and the new school of thought among our present day financiers is going to make this future safer and brighter. Agricultural engineers of our present generation, in my opinion, can best devote their energies towards the development of labor-saving machinery applicable to such wholesale usage rather than to that which will be primarily of benefit to the smaller land owner.

Many people argue against wholesale farming and feel that such a development would result in a lowering of the social status of farmers as a whole. However, would we not have a more contented farming community if our ten and twenty-acre farmers of today were interested in a large farming venture through stock ownership and were insured continuous employment at a definitely known wage, particularly so provided they at the same time enjoyed the ownership of a home with three or four acres upon which they could produce their vegetable and dairy products, etc. The uncertainty of income which the small grower now faces makes it almost impossible for him to live comfortably and plan ahead for the future with any assurance of his plans being realized. Regardless of the social complications which might result if my own conception of the problem is incorrect, from a business standpoint the large operating unit unquestionably will ultimately be responsible for the greatest share of our food production.

Engineer Observes Great Changes in California Delta

By D. C. Heitshu[1]

WHEN reading the April 1931 number of AGRICULTURAL ENGINEERING, with its account of the land reclamation meeting at San Francisco, my mind recalled the enjoyable meeting of the A.S.A.E. held at Lake Tahoe five years ago, with the interesting inspection trips through central California, and especially the Sacramento-San Joaquin Delta.

Going back to the Delta after five years, one finds that astounding changes have taken place in America's "Holland." To an engineer, the major changes are the increase in firmness of the delta lands, the change from orchards to row crops, the use of light-weight, high-speed tractors in place of large, heavy, slow-moving units, and the substitution of trucks for boats in the transportation of produce.

The increasing acreage in row crops in the Delta has brought the general-purpose tractor into prominence, and along with it a decided change in farm power. Today the small tractor rules in the Delta.

Corn, sugar beets, potatoes, onions, celery and asparagus constitute the Delta's row crops. Of these crops asparagus is the most interesting from the viewpoint of production equipment. The Delta has over 50,000 acres in this crop alone. It is the most important crop because of its value and its power and labor requirements.

Asparagus is grown in seven or eight-foot rows and was first produced by horse labor. A horse's life is very short in the peat delta lands because of the dust taken into his lungs while drawing implements. This brought the tractor, first the track-type and then the conventional four-wheel tractor, into use. These tractors which worked the crops by straddling the row or running between the rows, were unsatisfactory because the tracks or wheels packed the soil or injured the asparagus roots with their lugs, for in either case they operated close to the crop row. Another disadvantage was the tearing down of the beds during the "white grass" period.

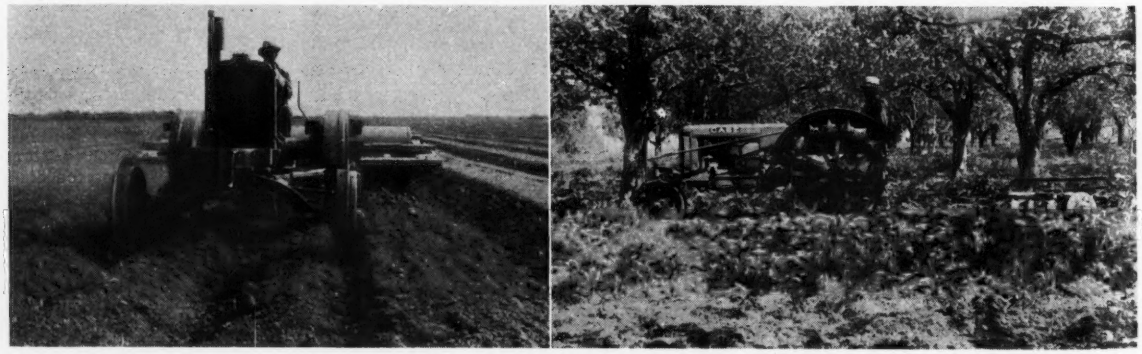
This brought the wide-tread, high-clearance, general-purpose tractor into the Delta. However, the growers were forced to design and build wide front axles, and make their three-wheel tractors into four-wheel machines. This was done and now one sees "swarms" of general-purpose tractors working in the asparagus fields. Another interesting observation is that practically all the new tractors are using the narrow type of rear drivewheel even on the loosest and lightest of soils.

In beets and corn, as in the other row crops, the general-purpose tractor predominates and merrily goes about its business even though it "shakes" the whole island. "Shakes" is used advisedly because these floating islands are one of California's "unusuals."

The orchards tell the same story. One hears the steady purr of a modern tractor and suddenly a smiling Jap and his little tractor appear among the trees. His rig is small, quickly maneuvered, and he is traveling four miles an hour, so by the end of the day he has actually beat his slow plodding brother on his old-fashioned tractor of the vintage of 1926.

When the Society next meets near the Golden Gate, a new Delta awaits the inquisitive engineer.

[1]Engineering department, J. I. Case Company. Assoc. Mem. A.S.A.E.



(Left) Ridging young asparagus with a general-purpose tractor with wide front axle which prevents wheel damage to the rows. (Right) General-purpose tractor being used in orchard culture

Some Engineering Phases of Fertilizer Application Experiments[1]

By G. A. Cumings[2]

AN IMPORTANT and intricate problem to be solved in the use of commercial fertilizer is that of application. From an engineering standpoint we are interested in application by machine.

Distributing machines have been in general use for more than a half century and thousands of patents have been issued on such devices. More or less superficial tests have been conducted on distributors from time to time. Manufacturers have developed various attachments and combinations of planters and distributors. Yet under conditions as they exist today there appears to be considerable room for improvement.

On the market at the present time there are numerous types of distributors, their operation being based on various mechanical principles. There are also combination planters and distributors, differing greatly in the manner in which the fertilizer is placed in the soil with relation to the seed. Furthermore, machines are widely different in weight, durability, ease of manipulation, convenience and accuracy of adjustment, maximum and minimum delivery rates, uniformity of fertilizer distribution, and the extent to which their operation is affected by changes in operating conditions, such as the drillability of the fertilizer, depth of fertilizer in the hopper, and the speed and inclination of the machine. It is hardly conceivable that all the different designs would have equal merit, even within groups of the same price ranges. Apparently fertilizer distributing machinery has not yet passed through the final stages of development, elimination and standardization. If the history of other farm machines is a criterion, we would expect that eventually not more than two or three types of fertilizer distributors would be in demand.

In the further development of fertilizer distributors the following points are among those to be considered in meeting the requirements of uniform distribution at low rates of application, accurate control of delivery rates, durability and convenience:

1. Positive dispensing action with fertilizers of a wide range of drillabilities
2. Avoidance of high amplitude of cycles or impulses of delivery
3. Elimination or minimization of the effect of head of the fertilizer and of inclination of the distributor, on delivery rate
4. Accuracy and refinement of dispensing parts
5. Provision for comparatively small changes in delivery rate and a suitable reference scale for adjustments
6. Provision for ready determination of actual delivery rates
7. Provision for ready emptying and cleaning
8. Greater use of corrosion resisting metals
9. In connection with planters, the fertilizer distributing unit to be accepted as an integral part of the machine rather than as an attachment

Until recent years fertilizer distribution had not generally been accepted as of sufficient importance to justify an exhaustive scientific study to secure fundamental information which would permit more intelligent designing and improvement of machines. This attitude changed with the introduction of more concentrated and highly soluble fertilizers for it was realized that these materials must be applied accurately in small quantities and placed in proper relation to the seed. In the adaptation of fertilizer distributing units to planters, cultivators and transplanters the lack of fundamental information was also realized.

Interest in machine application of fertilizers is not confined to this country. In England, Germany, Denmark and other countries recent studies have been conducted on the performance of fertilizer distributors under both laboratory and field conditions. Their work deals principally with broadcasting machines.

At the present time the U. S. Department of Agriculture, in cooperation with certain state experiment stations, fertilizer and machinery manufacturers, and technical societies, is undertaking a comprehensive study of the mechanical application of fertilizers. Our work to date has dealt with row application which is the prevailing practice. However, our new project will probably not be limited to row application, for broadcasting is being practiced more extensively with the increased use of fertilizers on pastures, hay lands, golf courses, etc.

In experimental work on the mechanical application of fertilizers with particular reference to combination planting and fertilizer distributing machines, there are two functions of the machine which must be controlled and varied: (1) Delivery of the fertilizer, and (2) placement of the fertilizer in the soil in relation to the seed.

With most types of distributors the delivery of fertilizer is materially affected by changing conditions. This phase has been discussed in considerable detail[3]. It has been found that the operation of most distributors depends wholly or partially upon gravitational flow of the material at some point in the dispensing mechanism, and this feature of the machine is a good indication of the extent to which delivery of fertilizer will be affected by changing conditions. Some variable factors affecting the delivery of fertilizer are: Drillability, apparent specific gravity, water content and compacting characteristics; inclination of the machine; depth of fertilizer in the hopper; rate of travel of the machine, speed of the dispensing mechanism; adherence of fertilizer to the mechanism; effectiveness of agitators; and wheel slippage, which varies with a number of conditions. The application rate under normal conditions for a

[1]Paper presented at a meeting of the Southern Section of the American Society of Agricultural Engineers, Atlanta, Georgia, February 1931.

[2]Agricultural engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. A.S.A.E.

[3]"Factors Affecting the Mechanical Application of Fertilizers to the Soil," U. S. Department of Agriculture Technical Bulletin No. 182 and "Field and Laboratory Studies of Fertilizer Distributors for Cotton," by G. A. Cumings, A. L. Mehring and Ward H. Sachs. AGRICULTURAL ENGINEERING, Vol. 11, No. 4 (April 1930) pp. 149-160.

The use of fertilizer will inevitably increase, and the matter of application will become more and more important. It is highly important that placement be accurately controlled in all tests. There is an opportunity for the agricultural engineer to be of some service in any tests where fertilizers are mechanically applied

certain adjustment may be greatly decreased or increased with most machines, by changes in operating conditions.

The situation is not as serious as it might appear, for every machine is not affected by all conditions and conditions are not varying all of the time. In fairness to the implement manufacturers I might say that with the more commonly used types of commercial distributors now on the market, operating under favorable conditions on the farm, the higher application rates, particularly, can be fairly well controlled by intelligent manipulation. On the farm fertilizer is purchased in large lots and large acreages are covered, offering an opportunity for a careful operator to keep a constant check on the application rate and to make adjustments accordingly.

In experimental work we have an entirely different situation. A number of different fertilizers are used, plats are small, rates of application must be varied, other requirements of the experiment must be observed, and at the same time any significant variations must be eliminated. In attempting a well-controlled experiment of such a nature with types of commercial distributors now commonly used, there would undoubtedly be some uncertainty about the application of the fertilizer.

For our experimental work we have selected the top-delivery type of distributor having a revolving, cylindrical hopper. It has what might be considered a positive delivery action. Its operation is not affected by most of the variable conditions previously mentioned. Doubtless you are familiar with the operation of this machine. The hopper consists of a vertical cylinder with a moveable diaphragm as a bottom. The entire mass of fertilizer revolves with the hopper and is gradually pushed upward by the diaphragm, the vertical motion of which is controlled by a threaded rod. The fertilizer moving at the top is shaved off by deflector blades and directed into the delivery tubes.

The Bureau of Agricultural Engineering has had several special combination planters and distributors built to specifications for use in fertilizer application studies. Further improvement and refinement is contemplated and we shall be glad to consider any suggestions that might be offered.

The operation of these machines is not affected by the condition of the fertilizer, inclination or rate of travel of the machine, or speed of the dispensing mechanism. There is no agitation of the fertilizer. The design of the mechanism is such as to give uniform distribution of a free-flowing fertilizer. The only variable factors that would tend to change the delivery rate of a fertilizer are compacting of the material in the hopper during operation, and variation in the slippage of the drivewheels. Compacting of the fertilizer during operation is largely eliminated by thoroughly settling the fertilizer before operation starts, and variation in wheel slippage becomes negligible when the seedbed is well prepared and effective lugs are mounted on the drivewheels.

Another advantage of this type of machine for experimental work is the fact that more than one delivery tube can be attached to the hopper. The fertilizer can be diverted through one, two, three, four or more tubes, and the quantity passing through any tube can be accurately varied under positive control.

The second phase of mechanical application is the placement of the fertilizer in the soil. Most of us engineers, and some of the other scientists, have been saying for several years: "It is up to the agronomists to tell us where the fertilizer should be placed in relation to the seed." In one sense that has been a mistake. From my experience in experimental work for determining the proper placement of fertilizer I would say that the conduct of such tests by machine is 50 per cent engineering. In this work the engineer should assume the responsibility of providing suitable equipment to meet all the varied requirements of the tests and then supervise all operations in connection with the application of the fertilizer to insure accurate functioning of the machine. The agronomists and other scientists then should make the observations necessary to determine the effects of each treatment and to give the reasons for differences in the development of the crop in the various tests.

Fertilizer placement involves so many different crops and conditions that an exhaustive study will require considerable time and effort. These conditions for many crops include the different fertilizers at various rates of application on representative soil types under various climatic conditions, both when all the fertilizer is applied at planting time and when the application is split to be applied at various intervals according to quantity or according to the plant-food ratios. In addition, the kind of seedbed and planting of the seed have some bearing on the problem.

It has been my observation that accurate relative placement of fertilizer and seed cannot be obtained where the two are applied in separate operations, whether the work be done by hand or by machine. A combination planter and fertilizer distributor can be used to advantage where the tests are not confined to unusually small areas for it insures uniform work throughout the experiment and eliminates any personal element that might enter. For the most accurate machine placement the fertilizer and seed tools must be mounted on the same frame and the seedbed must be level and uniformly prepared.

In our work on cotton in South Carolina we have used 18 different placements of the fertilizer on 3 soil types, namely, Ruston fine sandy loam, Norfolk coarse sand and Cecil sandy clay loam. A 4-8-4 fertilizer (nitrogen given first) at 800 pounds per acre was used for the major part of the work. An 8-16-8 fertilizer was also used.

The placements included contact with the seed, 1.75-inch and 3.25-inch bands placed at various depths below the seed, bands 2.25 inches and 3.75 inches to the sides of the seed and at different depths below the level of the seed, mixed with the soil under the seed and in two tests one-half the fertilizer was applied at planting in a band below the seed, the balance side-dressed later. Some striking differences were noted. I cannot go into detail but will give you some of the general indications.

Placing the fertilizer in contact with the seed, as some of our combination machines do, ruined germination on all soils as was experienced in the previous year's work.

On the sandy soils under existing dry conditions, germination was satisfactory only where the fertilizer was placed three or four inches below the seed and at the sides of the seed. Two important factors are apparent in considering the placement of fertilizer at the sides, (1) roots of the seedling do not immediately come in direct contact with the fertilizer or salt solutions; (2) by the use of single-disk furrow openers the soil remains undisturbed and more firm where the seed is planted. Yields for placements at the sides of the seed were highest, largely due to lack of injury and deterrent effects.

On the sandy-clay loam soil under favorable moisture conditions immediately after planting, there were no significant differences in germination and yields varied inversely with the distance of the fertilizer from the seed, excepting when in contact with the seed. The yield with the fertilizer one inch from the seed was 350 pounds of seed cotton higher than when at five inches from the seed. In the final recommendations on machine design, the assurance of a good stand under average conditions will be an important consideration.

Refinement of distributing machines to secure more uniform application of fertilizer appears to be economically feasible, for a significant reduction in yield of cotton was found where the fertilizer was distributed irregularly.

In conclusion, I might say that the use of fertilizer will inevitably increase, and the matter of application will become more and more important. There should be close cooperation on the part of the agricultural engineer in this work. Since results on cotton indicate that yields vary with relatively small differences in fertilizer placement, it is highly important that the placement be accurately controlled in all tests. For that reason there is an opportunity for the agricultural engineer to be of some service in any tests where fertilizers are mechanically applied, whether these tests relate to varieties of the crop or kind, placement and application rate of the fertilizer.

The Management of Large Farms[1]

By R. L. Adams[2]

THERE is so close a community of interests between the agricultural engineer and the farm manager that it is good for us to get together occasionally for a mutual exchange of ideas. We speak the same language—that of dollars and cents, of properly organizing and equipping a farm business, of justifying our work by financial tests, of efficiency, of improvement.

Because of the indefiniteness of the term "large-scale farming" it is cutomary, during the preliminaries of a presentation of this kind, to spend a few minutes in an attempt to clearly set forth just what the speaker means by the term. Several conceptions are going the rounds. For convenience these may be classified into four groups: (1) Large-sized family farms; (2) chain or group farming; (3) factory farms; and (4) managerial service.

EXAMPLES OF LARGE-SCALE FARMING

A few figures on and examples of large-scale farming, based on the classification just outlined, should help to a better understanding of what each entails.

Large Family Farms. In a recent publication written by Tolley and Holmes under the auspices of the U. S. Department of Agriculture the statement is made that both in terms of investment and in total acreages a remarkable change has taken place during the post-war period in the size of the family farm. These changes are most marked in the Great Plains area stretching east and south from Montana, through Kansas and Oklahoma, into Texas, New Mexico and Arizona, and in the western corn belt.

According to Grimes[3] large-scale farming in the wheat-belt is developing in response to economic forces that make it appear inevitable. In Wyoming and Montana during the last decade the size of the average wheat farm has tended to increase from an average of 320 acres to from one to one and a half sections.

Yet generally the change toward larger family farms is not marked. An inspection of the census figures for each decade since and including 1880 and 1925 show no material change. The average sizes for these years are 1880, 134; 1890, 136; 1900, 146; 1910, 138; 1920, 148; 1925, 145.

The 1930 census is likely to show more marked changes, especially in Montana, Wyoming, New Mexico, Arizona, Nevada and other states. Here are a few selected figures: In 1930 compared with 1920 the average size of Arizona farms increased from 582 to 746 acres; Montana, from 608 to 929; Oregon, from 268 to 302; Kansas, from 275 to but 283; Illinois, from 135 to but 141. On the other hand, California, Washington and Mississippi (to cite a few examples) register drops during the last decade as follows: California, from 250 to 209 acres; Washington, from 200 to 191 acres; Mississippi, from 67 to 59 acres. Apparently emphasis must for the present be placed on potentialities rather than upon actualities.

Chain or Group Farming. Group or chain farming is no new thing in these United States. This is the plan which for many decades has persisted in the old South under the name of the "plantation system." Here the landlord or his representative manage the operations of a considerable group of "croppers," farmers who contribute practically nothing but labor and receive their compensation in the form of a share of the crop.

Other examples are the Sibley Estate in Illinois, a 12,000-acre property, divided into standard sized farms, formerly 80 acres, subsequently 160 acres, and ultimately 320 acres per farm; and two chains of dairy farms (11 and 17 farms) in southern Wisconsin, farmed under the half-and-half dairy lease basis common to the vicinity.

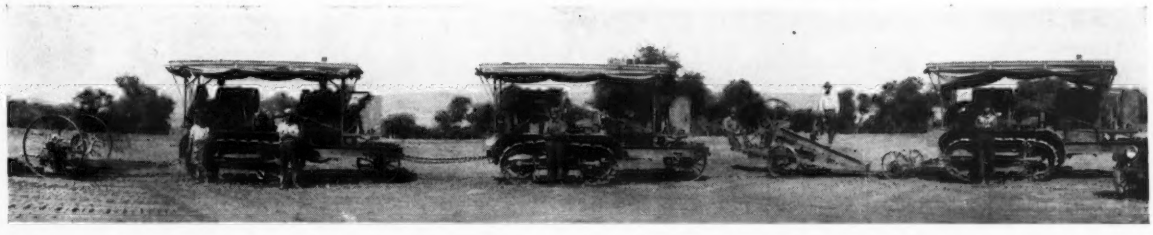
A chain of farms recently attracting much attention is that of the Fairway Farms Corporation, operating 12 Montana farms, none of which are closer than fifty miles from one to another. This corporation, started in 1923, set up two objectives: (1) to try to facilitate farm ownership, and (2) to experiment as to the possibilities of carefully planned farm organizations designed to fit the conditions of Montana. These farms are on land that was abandoned in 1920, and range in size up to 1,000 acres. The principal crops are wheat and corn. In certain years considerable livestock is fed, and all farms combine some livestock with crop farming. The use of power machinery and the handling of a large acreage with a minimum of labor is an essential feature. Tenants handle the farming details. Here in California we have several examples of this sort of thing.

Attention also may well be called to trials in the group management of farms that banks have had to take over by foreclosures. The Federal Land Bank for the 11th district is handling over 140 farms. The California Farms, Incorporated, has farms on its hands running well up in the hundreds. Attempts are being made to actually farm these properties with hired laborers, under the direction of paid managers. These trials will be watched with more than passing interest. One should bear in mind, however, that these groups are working with the less desirable farms, most of them being distinctly marginal or submarginal in nature. Otherwise buyers or tenants could be found. Many of the properties are of the one-crop specialized type. Many come to the bank badly neglected. Many are too small to constitute workable units. Many are in crops, the selling price of which is low—raisins, peaches, prunes, cotton, etc. Moreover, the interest of the banks in making productive units of these is secondary. Their chief aim is to salvage loans, preferably by ultimate sale of the properties rather than from sale of products. Maintenance of the investment value is therefore likely to overshadow mere operating details.

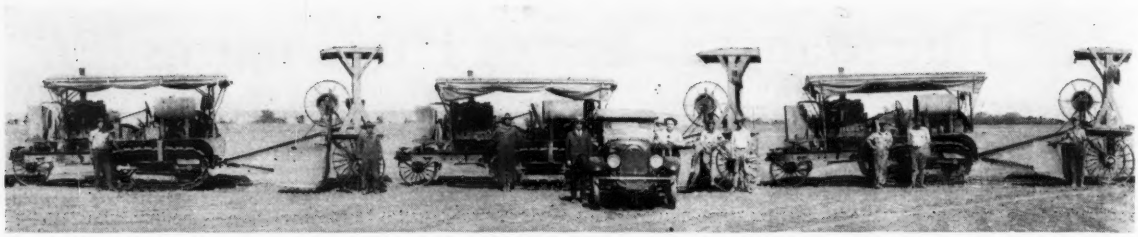
[1] A paper presented at a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers at Berkeley, Calif., May, 1931.

[2] Professor of farm management, University of California.

[3] W. E. Grimes, professor of farm management, Kansas State Agricultural College, in the "Journal of Farm Economics" for January, 1931.



Several units of a large layout of subsoiling equipment used on the large fruit farm of a canning corporation in California



Land levelling equipment used to prepare land for large-scale planting and cultivation

Corporation Farms. The most frequently quoted large-scale farm of the corporate type is that in Montana (near Hardin) of the Campbell Farming Corporation, operating 95,000 acres in wheat, flax, and other grains, under the management of Thos. D. Campbell. Here is an experiment in factory farming centering in the use of batteries of tractors and trucks, carefully conditioned by a central machine shop and a corps of field repair men. In speaking of this farm Prof. Wilson[4] indicates that the two things which most impressed him were (1) the work of servicing, done so efficiently that tractors remain in full operation for ten years or more, and (2) the unit plan of organization and manner of managing these units.

It may be a matter of surprise to some to learn that large-scale farming in the United States is already an integral part of our American agriculture. In 1924, 8,275 farming corporations filed income tax returns with the Bureau of Internal Revenue. In 1926 the number was 9,309. In 1927 it was 8,454. These thousands include corporations engaged in cotton, grain, fruit, livestock and general farming. Some idea of the magnitude of their operations can be gleaned from the following:

Total net worth (1924—7,014 corporations), $980,000,000

Gross income (1926), $709,000,000 (or a trifle under 6 per cent of the gross income of American agriculture).

Thus the average corporate farm has perhaps 20 times as many assets as that of the average farm, 23 times the net worth, and produces 26 times as much gross income.

Managerial service is a term applied to individuals or organizations who sell various kinds of administrative and organization service to owners of land.

The managerial service aspect is of rather recent growth. It concerns the activities of men of training and experience who have gathered together a cliente of owners, usually non-resident, for whom the tasks of planning and supervising are taken over under some agreed form of compensation, usually some stated fixed sum per year. This form will receive only passing attention at our hands, although it is a type of service that appeals to a farm management man and warrants more than passing attention in view of the service that, properly organized, it can be made to render.

CONDITIONS INFLUENCING THE SPREAD OF LARGE-SCALE FARMING

Thus far the trend toward large-scale farming, though steadily at work, is by no means much of an accomplished fact. Rather the reverse is true, for the tendency is for further subdivision of the large holdings, at least when demand for farm lands stimulates sales. The advantages of large-scale operation are offset by limitations, which mean that enlargement will be a slow and gradual process. We may well spend a moment or two in setting up some of the more outstanding advantages and then balance against these the more obvious disadvantages.

The outstanding influence that has been, and is, favoring the further development of large-scale farming is of primary interest to this group, since it centers in the development and utilization of large power units. Use of efficient tractors, multiple plows, disks, and other soil-handling machinery, combined harvester-threshers in place of binders and headers, trucks instead of horses, mechanical corn pickers, cotton sleds and strippers, and other ingenious labor-saving devices are increasing the output per man, or, to put it another way, are reducing their cost per unit of product.

In Oklahoma, for instance, a study conducted in 1929 of 102 cotton farms resulted in findings of labor income of $1,420 on farms where mules were used as against $2,032 on tractor-equipped farms. Cotton brought but 14 cents. The reasons for the better showing indicate:

1. The tractor farms operated, on an average, 190 acres of cotton, as compared to 143 acres of mule farms.
2. Feed cost on farms handled with mules was $4.10 per acre of cotton; feed and fuel cost $2.10 on tractor and mule farms. This saving is, however, offset to some extent by the higher overhead on tractors.

Omitting chopping and picking, common to all farms, the man labor per acre on tractor farms was 5 hours; on mule farms, 6.6 hours. This difference of 25 per cent is equal to 1 cent per pound saved on all cotton produced.

Tooteil (unpublished manuscript), by combining data concerning available days for each operation, rate of work per day, and total work to be done, finds that for Montana the efficient farm unit is as follows:

Acreage	Tractor-capacity
800	3-plow
1,200	4-plow
1,800	6-plow
3,000	12-plow

The plan calls for half the land to be seeded and the other half summer fallowed each year. Costs of handling favor the large power unit as shown below[5]:

Tractor size	Per acre cost
3-plow	$14.22
4-plow	12.37
6-plow	9.68
12-plow	7.60

The large-scale farm, therefore, primarily permits a reduction in costs, and any operation that will bring costs below selling price is certainly very much in order.

The next influence is the developing of men able and willing to manage large enterprises. Some writers point out the lack of brains to do this very thing, but I take issue with such statements. I admit the need for highly efficient organizing and executive ability. I claim, though, that there are such men available, though they may not shout their wares from the housetops.

For one thing the more successful practicing farm managers are not out making speeches about their work. They know that one good way to increase their troubles is to stimulate production, and silence may, with them, be an attribute of successful reasoning power. I have no doubt that, when conditions warrant, the needed ability will be forthcoming and in abundance. But, for the present, agri-

[4]M. L. Wilson, professor of agricultural economics, University of Montana.

[5]A compilation by the author, with labor figured at 30 cents per hour and with no allowance made for interest on investment, for taxes, for insurance, or for cost of management.

cultural returns are not sufficiently promising to tempt men from fields where the chances of material gains may be greater.

For the manager who can find a field for his services the rewards are certainly promising. Recently I was given the details of three such positions just filled, each having to do with a group of farms. Two men are drawing down $25,000 annually each; the third $30,000.

Timely preparation of seedbed, timely cultivation of crops and timely harvests are vital in farming. Frequently the time limits within which the work must be done are relatively short, a few days or at most a very few weeks. The fully equipped farm, be it large-scale or enhanced family unit, can be better organized with this end in view. It pays in better yields, in more land being planted and cared for, and in reduced costs.

The advantages of chain-farming are not obscure. It retains the family and farm combination with the operator living in the center of things, obtaining a portion of his living from the farm, and keeping down expenses, in part by the use of family labor other than the operator's. It permits full utilization of the plant. It retains the advantage of the operator giving that full degree of interest that attaches to a proposition in which he has a share in the outcome proportionate to the work, manual and mental, that he contributes. It permits the use of better management through improved technique. It entails the advantages of mass buying and selling. It permits transferring labor when and as needed, and likewise the use on several farms of the heavier and more expensive types of equipment.

Limitations are also important. The first is the need for greater amounts of capital. Farms of the wheat belt, when increased to from 2,000 to 6,000 acres, face additional capital needs amounting to from $50,000 to $200,000, for the added land, for equipment and for livestock. Kansas reports the average investment for Mead County to be $38,000 under the newer order as against $14,230 in 1925.

In Wyoming a recent study shows that the average capital required for grain farming in that state amounts now to about $35,000. On the farms which are horse-farmed and larger than the average the investment is $44,000. The tractor-powered farms, still larger in size, have an average capital investment of over $87,000.

Obviously the cost of the special and expensive machinery is an item. So too is the outlay needed for additional land. And the acquiring of additional land is beset with difficulties.

To secure the needed capital an assault must usually be made on the usual sources of credit. And then agriculture bumps head on into the competitive demand for money. Difficulties arise in that the evidence does not encourage bankers and other investors to become wildly enthusiastic over the possible returns for money invested in farming activities. The family farm hasn't thus far demonstrated a sufficiently high earning power, coupled with reasonable safety, to attract outside capital.

An inspection of the data collected from 74 large-scale farms already referred to is illuminating in this aspect. I made a brief summary of their findings to see what inducement a banker or a money lender or a capitalist would have to place his money in agriculture. Of the 74 farms 45 gave no information. Fifteen more were automatically eliminated by my gauge of large-scale farming for I omitted any whose gross incomes were less than $50,000 annually. This left 14 for further study. Of these 14, four gave no information concerning amount of capital invested and three more showed a loss, so that the final record gave 7 out of 74 reporting earnings. These 7 ranged as follows:

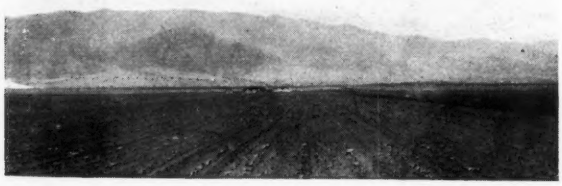
Capital	Rate of Net Income, per cent
$500,000	Broke even
550,500	0.8
200,000	1.0
500,000	3.9
150,000	6.0
100,000	9.4
1,000,000	13.5
400,000	15.4

Of course, if we concentrate on the last three, we have cause for optimism and rejoicing. On the other hand, if we concentrate on the first three we bury ourselves in a deep purple gloom. If, however, all farms were like these we would find a weighted average percentage earning of 8.6 per cent. Doubtless the sampling is too limited. I personally think it is. But we cannot sidestep the showing of what constitutes one of the best collections of data that we have, even though the best in this case is rather sketchy.

Earnings. A study of earnings[6] of corporations versus average farms indicates that "mere incorporation and increased size of farms offers no royal road to farm profits. Taken as a group, the incorporated farms make no better financial showing than the small family-sized farm," and again "the fortunes of the corporation farms follow the fortunes of the type of farming they are engaged in." Yet "a surprisingly large number of the farming corporations report high earnings. To secure greater net returns than are secured from the family type of farming, large-scale farming must achieve an efficiency considerably greater than the average of such farms now in operation," which constitutes a principle very well understood by all qualified farm management men. Thus large-scale farms are apparently no more, and no less, successful than the average of the family farms. Nor is there any uniformity in the success or failure of large farms (measured by financial returns)—they vary through wide extremes as do the small farms.

Large-scale farming not only requires more capital for investment purposes, but more attention must be paid to the building up of operating reserves. Much large-scale farming is devoted to the producing of a single product and this program carries with it risks of crop failures and of demoralized markets. Large-scale farming must compete with hosts of small family farms run by operators who are content (or obliged to be content) with an annual income less than their labor is worth, when figured on an industrial basis, plus interest on their farm capital. This is a high hurdle. Only by volume of business, decreased costs, and better selling can the large farm hope to overcome this handicap.

The cost of superior management is an item, and unless duly offset by corresponding economies may add to the operating burden. In this connection Johnson[7] gives a comparison of the cost of producing apples on 17 large manager-operated orchards in contrast with owner-handled farms. The managers produced at a cost of $1.44 per box and sold for $1.22; the owners at a cost of $1.17 and sold for $1.29. The managers' loss was largely due, says John-



A bean and barley ranch of several hundred acres, one of six such ranches owned by a single family. Each ranch is operated by tenants under the direction of a resident farm manager

[6] "Large-Scale Farming," U. S. Chamber of Commerce booklet. 1929. (In an unpublished manuscript by George M. Peterson a question is raised as to the validity of the conclusions on agricultural corporation returns in this reference. It is included here subject to reservations.)

[7] Neil W. Johnson, Washington Agricultural Experiment Station.

Part of a 3,800-acre orchard of peaches, apricots and other fruits planted in a solid block to facilitate large-scale operation

son, "to low yields, less desirable varieties, and the necessity for hiring all work done." The advantage claimed for the owners is mostly that of extra effort when needed, resulting in a greater output per day—and hence per dollar.

Then there is the difficulty of securing efficient farm hands and gaining that degree of interest and loyalty so necessary to economical production. Hired laborers on large farms usually will not work as long, as hard, nor as conscientiously as they will for some small employer, with whom they are likely to come in closer contact and whose problems tend to become their problems.

A class of paid managers step into the picture. And, defendant that I am of the farm manager and the efficiency that he stands for, yet I cannot fully feel that the land fares as well under a paid manager as it does under the kindly guidance of its managing owner.

THE SOCIAL ASPECT

Then there is the social aspect. Any increase in large-scale farming is bound to be accompanied by a crowding out of some individuals who at present are working for themselves. These will be forced into the tenant or the wage-earning classes. There is no present indication, however, that the expansion of large-scale farming will supplant the typical family farm with which the agriculture of all portions of the United States abounds. To date the circumstances resulting in large-scale farming have centered in some condition best handled on a large scale, such as the production of certified milk; or in the production of raw material needed by some plant, such as sugar beets for the beet mills, seed for seedsmen, canning fruits and vegetables for canneries; or in a single crop which lends itself to machinery operations, such as wheat and other grains; or in the production of livestock or livestock products under extensive range conditions.

Disastrous effects of large-scale farming upon the social life of rural communities, therefore, do not appear imminent. Until the time comes when this type of farming is manifestly more marked there appears to be no cause for fear. Fears that large-scale farming "will reduce the status of present independent proprietors to dependent corporation employees, regiment the farm population in the same manner as industrial workers, deaden the independent spirit of the countryside, cut off a prolific source of industrial and governmental leadership and destroy the tradition and institutions of rural life," appear to be immature.

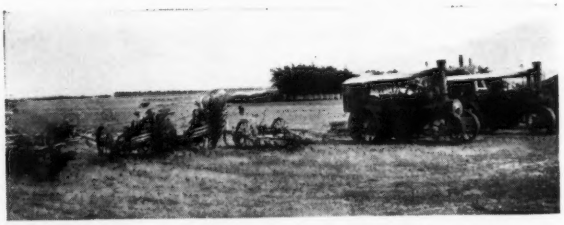
Whether or not large-scale farming will survive depends on how well it can meet the test of successful competition, a test which must center in superior efficiency in the use of agricultural resources. At the outset its full-rate labor payroll must compete with the product of the owner who, by reason of working longer hours or harder or for less returns, is producing his commodities at a low cost per unit.

PROBLEMS OF MANAGEMENT

The essentials governing the management of large farms are threaded throughout this discourse. Those who are making the greatest financial success of their responsibilities are primarily business men, men who understand and practice the fundamentals of organizing and administering. The inherent elements do not differ from the elements required in making a success of any farm. They do, however, vary in degree and direction. In our work we have developed a rather interesting chart for rating farm managers. The four major requirements focus upon (1) knowledge of agriculture, (2) organizing ability, (3) business ability and (4) personal characteristics. Generally we assign thirty points each to knowledge of agriculture and business ability and twenty points each to organizing ability and personal characteristics. For large-scale farms I am inclined to place a higher valuation upon business ability than upon knowledge of agriculture, and a higher rate upon organizing ability than upon personal characteristics.

Demands upon the managers of large-scale farms run the gamut of the whole field of farm management—both organization and administration. But special emphasis is of necessity placed upon certain features, such as:

1. Building up the personnel as this affects superintendents, foremen, bookkeepers, and others of similar status
2. Deciding upon what enterprises, in what amounts, and in what combinations shall constitute the core of the farm business
3. Determining such financial matters as capital requirements, followed by the necessary steps to procure the needed capital, especially when use is to be made of local banks
4. Determining the best method of handling the laborers—wages, hours, housing, boarding and supervision
5. Finding out what the business is doing by use of properly selected and properly kept sets of cost accounting
6. Deciding upon and procuring the best equipment compatible with the crops to be raised, the soils to be handled, the labor to be employed, and the general environmental conditions
7. Superintending the buying of necessary supplies
8. Marketing the products to the best advantage
9. Selecting suitable tenants, determining leasing terms, and advising as to the best type of contract to govern the relations between landlord and tenant
10. Analyzing and interpreting contracts and other documents
11. Keeping posted concerning legislation affecting the farm business
12. Finally, among other things, using his best efforts to enhance the profitableness of the various enter-



Steam power cable equipment used in raising beets on several thousand acres of land operated by the Spreckels Sugar Company in California

prises, by studying possible changes in enterprises, ways of increasing yields, ways of enhancing selling prices and ways of decreasing costs.

The management of the large farm is, in effect, the quintessence of applied farm management.

CONCLUSION

At the beginning of my talk I hinted at a possibility of a personal opinion. I have an idea that, reading between the lines, you know what it is. So far as the Pacific Coast states are concerned I do not see much justification for the introduction of the factory type of farming. Who can place his finger on any extensive tract of good land coupled with favorable climatic, transportation and other producing factors which is sufficiently economical to prepare, to equip and to operate that the investors will have assurance of a fair return upon their investment? I am speaking with the present condition of agriculture in mind. With more commodities being produced than can be absorbed at a profit to the farmer, with lands at a relatively high level, with labor still above a level justified by current returns the outlook doesn't lend much encouragement to large-scale farming of the corporation type. Look over the prices of fruits, of eggs, of milk, of beef, wheat, lamb, wool, cotton, etc., and point out where I am wrong. There is no encouragement for capital to reenter the agricultural field for this particular purpose. These conditions are already serving to exercise birth-control so far as corporate farming is concerned.

The situation is a bit different with the group type of farming, with the enlargement of family farms, and with the extension of the managerial service idea applied to agriculture. These, in response to a changing economic order, offer promise of substantial changes in the direction of larger units. This change is bound to be helped by the recent rapid increase in the amount and effectiveness of technical information applicable to farming, the intensely practical information relative to markets and marketing, the readjustment of production to market demand, the improvements in farm machinery and the advance in transportation facilities. Each of these three ways of enlarging the scale of farming possess possibilities for better management, better organization, more efficient use of machinery, some specialization of labor, and the benefits of wholesale dealings. There appears to be economic justification for these types of development. This trend is bound to create increasing demands for more and larger power units, for more serviceable buildings, for better financing, for improved marketing, for increased cost accounting, for more real business. And if my prognostication is correct, the agricultural engineer and the farm manager are mutually facing a task that will call for the best that each can give. For one, I welcome this coming, and larger, opportunity for real service.

Factors Influencing Power Demands of Electric-Motor-Driven Threshers[1]

By Truman E. Hienton[2]

THE potential load of 1,200,000,000 horsepower-hours (USDA Department Bulletin 1348) annually required for threshing purposes in the United States led to early efforts to determine the power demands of threshing machines, in connection with studies relating to the use of electricity in agriculture. These studies included those of the University of Minnesota during 1924, 1925 and 1926, State College of Washington in 1928, the Northern States Power Company and the Detroit Edison Company in 1929, and Purdue University in 1929 and 1930.

Threshing with electric power was not a new use of electricity on farms in the United States or in foreign countries when the University of Minnesota studies were undertaken. A central Indiana power company, during 1914 and 1915, rented a 15-horsepower, single-phase motor to farmers on its lines for operating threshing machines and silage cutters. Another electric power company, located in the southern part of the state, secured a 25-horsepower, 2300-volt, three-phase motor about 1920 for a small group of its customers to operate similar machines. Recommendations of motor manufacturers on sizes of motors satisfactory for driving threshing machines were a 15-horsepower unit for a thresher with 19-inch cylinder and one of 40-horsepower capacity for a machine with a 32-inch cylinder.

Reports issued by the U. S. Department of Commerce in December, 1924, on rural electrification in foreign countries, indicated that prior to that time electric motors had been used to operate threshing machines in Denmark, New Zealand, Finland, Italy, France, Holland, Sweden, and Great Britain. Sizes of motors used in these foreign countries ranged from 7.5 to 50 horsepower.

During the first year of the Minnesota studies, a 15-horsepower, single-phase motor was used to drive a 22x36-inch separator. This motor was replaced in the two succeeding years by a group of three single-phase motors totaling 14.5 horsepower. A 10-horsepower motor was used to drive the cylinder, a 1½-horsepower variable-speed unit to drive the shoe and shaker, and a 3-horsepower motor to drive the stacker fan. The average power demand of all the motors was about 11.9 kilowatts while operating a machine equipped with roller bearings during the 1927 threshing season. The power demand of the machine running empty was about two-thirds of that while threshing.

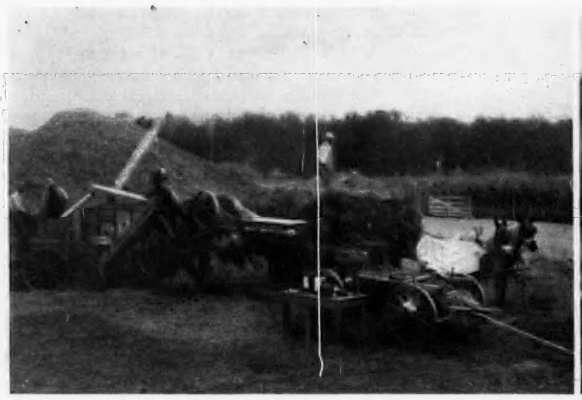
The use of three electric motors to operate one machine was continued by the Northern States Power Company in tests conducted during the summer of 1929. The motors used were of 7.5, 3, and 2-horsepower capacity, operating respectively the cylinder, shaker, and wind stacker. They found that the power demand of the 21x36-inch thresher was 9.1 horsepower (6.8 kilowatts) running empty at full speed, later reduced to 8.6 horsepower when the motors had been in operation for some time. The power demands of the various parts in the first power determination was 2.6 horsepower for cylinder and feeder, 3.05 horsepower for the wind stacker, and 3.45 horsepower for the shaker. The speed at which the power demand of the stacker fan was taken was 693 rpm, while the usual speed is 830 rpm. They believe that the slower speed will be satisfactory for all kinds of threshing.

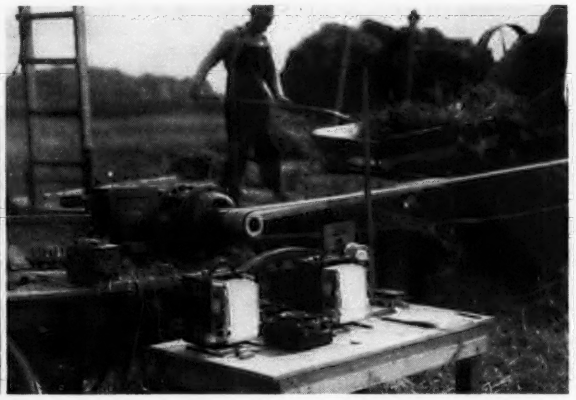
In the 1928 season the State College of Washington conducted some tests of threshing with one electric motor. A 20x28-inch thresher was operated by a 10-horsepower, single-phase motor with an average power requirement of 8.5 kilowatts (9 to 10 horsepower) when threshing a bushel of barley per minute. The energy consumption for threshing 13,362 pounds of oats and wheat and 7,446 pounds of barley was 90.3 kilowatt-hours, an average use of 8.68 kilowatt-hours per ton.

Equipment somewhat similar to that used in the Washington studies has been used in the tests conducted at Purdue University. A 20x32-inch thresher, equipped with ball bearings on the cylinder and roller bearings on the stacker fan, was operated by a 10-horsepower, single-phase motor. The capacity of the machine was given by the manufacturer as 40 to 80 bushels of wheat per hour or 65-130 bushels of oats per hour.

[1]Paper presented at the Rural Electric Division session of the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Project leader in rural electrification, Purdue University, Lafayette, Ind. Mem. A.S.A.E.





(Left) This picture shows the operation of a 20x32-inch threshing machine with a 10-hp electric motor in the tests conducted by Purdue University in August 1930. The maximum rated capacity of the thresher was exceeded by 27 bushels of oats per hour in one test with the motor at rated load. (Right) Close-up view of motor and electrical instruments used in the Purdue tests

The work in 1929 was confined largely to determining the power requirements of the machine when operated according to the recommendations of the manufacturer. During wheat and oat threshing the cylinder and stacker fan speeds were 1080 and 940 rpm, respectively, when running empty. An average overload of 24 per cent was experienced in threshing wheat at the rate of 48.8 bushels per hour, and 14 per cent in threshing oats at the rate of 88.9 bushels per hour. In threshing soybeans, the cylinder speed was reduced from 1080 to 720 rpm (no-load speeds) to avoid cracking the grain while the stacker fan speed was increased slightly from 940 to 980 rpm. The average power output of the motor exceeded its rating by 11 per cent while threshing at an average capacity of 42 bushels per hour. A reduction of stacker fan speed from 980 to 630 rpm resulted in a decrease from 11.1 to 7.2 horsepower and a decrease in capacity per hour from 42.0 to 36.2 bushels. In the latter case, however, a considerable amount of loose material was threshed while in the former all soybeans threshed were in bundles.

In 1930 efforts were made to determine the effect on power demands of the thresher by reducing stacker fan speeds and also to learn the limit of such speed reduction. A test was made with the machine running empty using various speeds of the stacker fan, between wheat and oat threshing tests. The watts input to the motor at the various speeds follow:

Cylinder Speed, 1190 rpm		Cylinder Speed, 1090 rpm	
Stacker fan speeds, rpm	Total watts demand	Stacker fan speeds rpm	Total watts demand
1020	6800	945	5300
845	4700	785	3800
755	4000	695	3100
665	3300	615	2700
Idle	2100	idle	1800

These figures show clearly the effect of stacker fan speeds upon power requirements. The variation in power demands caused by changing the speed of the cylinder is not significant, as the figures given for the stacker fan idle include all power used by the threshing machine.

The threshing tests verified the effect of reducing power requirements by lowering stacker fan speeds. Using a no-load speed of 1170 rpm for the cylinder in threshing wheat, the average power demand was 13.6 horsepower (12.4 kilowatts) with the stacker fan at 1020 rpm (no-load speed). Under similar conditions the power demand, with stacker fan speed reduced to 840 rpm, was 12.5 horsepower (11.4 kilowatts), and at 755 rpm it was 11.7 horsepower (10.6 kilowatts).

The cylinder speed of the thresher under load, while threshing wheat, exceeded that recommended by the manufacturer (1100 rpm) so that it was reduced for the oat threshing tests to 1090 rpm. It is possible that the difference in power requirements between threshing wheat and oats, with stacker fan speeds approximately the same, 755 and 785 rpm, respectively, may be partly attributed to this reduction in cylinder and shaker speeds. It will be noted that, while the stacker fan speed was reduced to 695 and also to 615 rpm, no significant change in power demands was experienced. It may be that a further reduction in power demands might have been experienced but the oats threshed, using the fan speed of 615 rpm, had been cut less than one week and were very damp having been rained on after they were cut and before they were placed in the shock.

The limit of reducing the speed of the stacker fan on this machine was reached in threshing wheat at 755 rpm. The straw bridged four times during a morning's work beyond the last straw-rack riser and before it reached the fan. Apparently the air suction of the fan was not adequate to overcome the effect of the friction of the straw with the rear end of the machine. No difficulty was experienced in threshing oats at a speed of about 695 rpm, but the speed of 615 rpm was unsatisfactory due to the fan failing to handle the rather wet straw. The failure of the wheat straw to reach the fan may have been due to its length, which was about 30 inches. The first two lots of oats shown were somewhat shorter, but the last two were nearly as long as the wheat.

The results of this work corroborate similar findings on the power demand of stacker fans which have been reported by engineers of the Hydro-Electric Power Commission of Ontario in their studies on energy required for threshing (Electrical World, Vol. 93, No. 5), and by engineers of the Detroit Edison Company, and of the Northern States Power Company, in their work in 1929, as well as that by a German engineer, Dr. C. H. Dencker, who has made a series of studies on hay and straw blowers (Die Technik in der Landwirtschaft, Dec. 1928, Feb. 1931).

The agreement of the results of these various investigations on the possibility of reducing power demands of threshing machines by lowering stacker fan speeds warrants the attention of manufacturers despite the spread of the combine and its apparent future. Additional investigational work to determine other possible reductions in power demand should also be of interest to manufacturers and agricultural engineers. The small thresher will continue to be used in the future and its operation by electric power can be made entirely practical. An increased demand for threshers with lower power demand can be expected from farmers as the present spread of rural electric lines continues.

Land Reclamation as Affecting Farm Machinery Application[1]

By John Swenehart[2]

ANY agricultural improvement based on reduced efficiency or on failure to use the best methods and facilities is obviously unsound and will fail regardless of subsidy or sentiment. Since land is basic for all agriculture, the best use of land is an important problem of the power-farming engineer. (Obviously a consideration of the problems of land must be on a long-time basis and not for 1930 conditions.)

The operating department of agriculture as an industry is made up of 6⅓ million farms, having approximately 55 crop acres per farm, or a total of 350 million acres. Sixty per cent of these farms have less than 100 acres in crop, and 38 per cent have less than 50 acres, and more farms have less than 25 than more than 175 acres.

Just as the manufacturing industry has written off the entire cost of obsolete, poorly located, or otherwise high-cost-producing plants, just as high-cost low-producing mines are abandoned, just as the village blacksmith has given way to the garage and machine shop, so must agriculture, as an industry, write off those hundreds of thousands of so-called farms which are but a group of "patches" tillable only by hoe methods.

That this writing off of small farms means at least temporary distress to those farm operators must be admitted, but it is little different from the distress suffered by thousands of coal miners who are out of work because people burn oil and gas. Probably tens of thousands of farms can fall to no further depth of distress than those indicated by surveys made in various states throughout the country—north, south, east and west. About a year ago the U. S. Department of Agriculture announced that over 100,000 white farmers in the Piedmont District of the Southeast received an average income of only $310.00 annually per family of five. In the New England states and elsewhere conditions somewhat similar exist, but abandonment occurs more readily on account of climate. Yet in these same areas there are ample evidences of success where modern methods and modern machinery are used.

"We need no more land under cultivation." This sweeping statement is the subject of a recent article by Director Mercier of Louisiana in the "Progressive Farmer." This statement is perhaps true but incomplete and therefore misleading. The question is, Which land do we need? Do we need washed-out, worn-out or otherwise inferior land, originally brought under cultivation only because it was near market centers, before loads to the market changed from the backs of men to modern transportation. Must our agricultural improvement continue to nurse these farmers through an incurable poverty? Shall we continue to rebuild these lands as long as better land is available and accessible? Have we not, let us hope unwittingly, nursed inefficient farmers, made so because their land is not or can not be improved to meet farm competition? The patch farmer competes with modern farming only by harder work, longer hours shared by wife and children and with returns too scant to maintain a fair living standard. Not more land, then, but which land.

In the beginning of our farm development in America the colonists, with no transportation, were compelled to cultivate land immediately at hand, removing forests and using the virgin fertility supplementing it even then, as history tells us, with fertilizer in the form of fish. Next follows the importation of the negro in the warm climates of the South. Then the northern pioneer, following rivers and streams to reach new virgin land. In about 1850 begins the development of the prairie West, at first only the offshoot of mining and prospecting. Many of the forty-niners searching for gold failed to find it in that form and settled in various parts of the West. Reclamation so far had been largely a pioneer movement.

By an Act of Congress in 1902, so-called federal reclamation was begun; in fact, this seems to have been almost the first general use of the word. While much has been said of the great areas affected by irrigation reclamation, it is significant to note that only four-tenths per cent of our crop land is included in federal reclamation projects and that the settlement in all federal reclamation projects in number of farms during the first 20 years of its operation was approximately the same as the number of farms developed in the three lake states during the same period. The total, therefore, represents a small part of the agricultural industry.

The development of land passed entirely across the country, and the desire for farms is being satisfied by a second wave beginning again in the eastern part of the country. Originally reclamation was considered to include only the improvement of large areas by extensive engineering construction and organization. Now reclamation is much broader in application. The word is accepted to include drainage, irrigation, erosion control, land clearing, stone removal and forestry. Naturally it includes the maintenance of all of these. Possibly the entire task of building up washed-out or worn-out farms, including the use of fertilizers, should be considered as land reclamation. The word is no longer exclusively applied to large areas, or to the arid and semi-arid west, but represents a major problem in Pennsylvania, Wisconsin, North Carolina, Iowa and Louisiana.

Wholesale abandonment and the accompanied adjustment by land reclamation, while probably the only relief for agriculture as a whole, is not going to take place. place.

In Pennsylvania or Wisconsin, for example, homes have been established with large expenditures for buildings and other improvements. These buildings and improvements represent life-time efforts—sometimes of several generations—and will not be abandoned. The advent of power machinery has thus created a new reclamation problem when these farmers must equip themselves to compete with the large farms in the Middle West. One-half the farms of Wisconsin have less than 50 crop acres, yet there are 60 to 80 acres still unimproved on these farms. Fields are small and irregular in shape. It is this sort of land reclamation that the farm machinery engineer must consider.

Several factors are involved in the reclamation of fields on old farms: (1) The size of farm as affected by high-valued crops grown, (2) the nearness to points of consumption, (3) labor competition, (4) the physical reclamation job, and (5) machinery adaptations.

In connection with farm machinery operation, the size of farm is commonly considered in terms of total acreage. While the farms in the dairy and diversified farming sections are comparatively much smaller than in the middle west areas where large farms are common, the kind of crops grown mean a larger number of field operations. Forty acres, requiring twenty field operations, means a total of 800 acres covered, whereas a 100-acre farm where only eight operations are necessary due to the kind of crops grown, the total area covered would be only 800

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[1]Paper presented at the Power and Machinery Division session of the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Manager, agricultural section, Atlas Powder Co., Wilmington, Del. Mem. A.S.A.E.

acres. This situation is making possible the use of machinery on farms which could not be justified except by high-valued crops.

In our older farm regions where centers of population and industry are near at hand, the farmer does not have to pay a freight tariff of at least 25 per cent of the crop value, which is required where products are produced at distances from population centers. Using Pennsylvania as an example, the local farmer has an advantage in the price on potatoes of from 25 to 40 cents per bushel on actual freight.

The migration of farm labor toward the center of industry due to higher wages in the factories is inevitable where hand methods are used on small farm fields. With larger farms, on the other hand, larger units of land and larger units of equipment justify higher wages which more successfully compete with the wages paid in industry. This is a point very frequently overlooked.

These three aspects of farming seem to justify the increased effort toward complete reclamation of farm fields in many northeast and north central states. They justify a new attitude toward reclamation. This involves not only a further study of the specific reclamation work needed, but a further study and development of farm machinery suited to meet conditions in this large area of the United States, which in the past has either been considered fully developed or worn out.

Actual reclamation work on these existing farms involves stone and boulder removal, stump and hedge row removal and water control. The recognition of these problems is essential not only to the development of machines but to the promotion and use.

In a farm machinery survey in Pennsylvania under the direction of R. U. Blasingame, reported in Bulletin 237 of the Pennsylvania Agricultural Experiment Station, some very significant facts are found. A representative group of farmers from representative counties were studied from the standpoint of the application of farm machinery. The average number of fields on the farms in six counties was six. These fields averaged in size from 8 acres in Clearfield County to 15 acres in Center County. It is further noted that rock ledges were obstructions to the use of machinery on 52 per cent of the farms in Erie County, 64 per cent of the farms in Center County and 24 per cent of the farms in Lancaster County. It will be remembered that Lancaster County is famous as one of the leading agricultural producing counties in the United States.

Blasingame's studies carry us farther with this problem on a 40-acre unit of the Pennsylvania Experiment Station Farm, where complete reclamation has been accomplished and power farming applied. The corn crop has been completely produced with a general-purpose farm tractor at a cost per acre of 5.22 man-hours plus 1.43 man-hours required for adjustments, repairs, setting-up equipment, travelling to and from fields. This compares favorably with results secured in what are ordinarily considered most favorable sections. It is interesting also to note that the cost of reclamation on one 8-acre field amounted to approximately $15.00 per acre. This reclamation cost involved labor, use of tractor and teams and explosives. The rock ledges were broken and removed from the field to an adjoining wooded tract.

This relatively small reclamation cost made possible economical and effective power farming. This was done under conditions which were not exceptional and can be easily duplicated in large areas in Pennsylvania and other states.

In connection with experiments on the reclamation of different land which contains occasional outcroppings of limestone ledges, a need was developed for a hook or plow which could be used to loosen and pull rock fragments to the surface. Ordinary subsoil plows are too heavy and too costly for practical use, yet the full and rapid development of machinery would seem to demand commercial manufacture of some suitable device. A special stone hook was devised in these experiments, but more trial and study is desired. In connection with tractor operation, the use of the tractor for these reclamation jobs means a greater use per year and reduced overhead cost.

The final disposal of the stone fragments involves still further effort. At present this is being done in much the same manner as it was done in the building of the pyramids, only that we have no cheap slaves. Some method of loading and hauling rock fragments is needed. Perhaps a homemade device will for a time be valuable from a promotion standpoint. The homemade mallet stump puller, so-called, received publicity far in excess of any possible usefulness, but it served to bring a problem to the attention not only of the farmer but of all others interested. Few mallet stump pullers were ever made, but I personally sent out thousands of specifications.

In the central glaciated regions, rock outcrops rarely occurred, yet glacial boulders are common obstructions in farm fields. Sometimes these boulders are on the surface but more frequently partially underground so that their removal is more difficult.

Perhaps little comment is needed in connection with removal of stumps and hedge rows. Work already done has developed methods which makes stump removal comparatively easy and low in cost on lands suited for farming. The farmer even under present conditions is using 10 or 12 million pounds of explosives for agricultural purposes annually, and the tendency seems to be upward.

With Iowa using over 400,000 pounds of agricultural explosives and Illinois nearly as much, it is evident that field improvement is going on even in apparently well-developed agricultural sections.

In travelling west of Memphis, Tennessee, I talked with a colored farm tenant. We had noticed that the cotton was 18 to 24 inches tall some distance to the west, whereas in this Memphis district the cotton was only 5 or 6 inches tall. When we asked the negro why his cotton was so small, he pointed to an old ditch filled up with sediment so that it would not function.

In the United States there are about one million farms having artificial drainage and approximately another million needing drainage. About one-half billion dollars is invested in drainage work. About 110,000 miles of open ditch requires maintenance. Failure to maintain this extensive drainage means hand labor. A tractor is at a great disadvantage. Not only is it necessary to maintain drainage in the delta and alluvial regions along the rivers, but on hundreds of thousands of farms in nearly every state wet spots in farm fields are holding back or preventing entirely the adoption of modern machine methods. Ohio is one of the leading states in the mileage of open ditches and the cleaning of these open ditches is becoming more and more important as the accumulation of sediment takes place. Most of these ditches have been dug with large dredges and so long as a large yardage is to be moved, these machines are effective, but on small clean-out jobs the equipment is generally too costly.

Explosives have a very important place in this clean-out work, but it would seem desirable that some tractor application be devised.

Drainage engineers point out that most open ditches need to be cleaned once every five or not to exceed once in ten years. This means that this maintenance work is not merely one reclamation job but rather a continuous one.

In conclusion, we would suggest that two phases of perhaps equal importance need attention:

1. The development of equipment and method
2. The promotion of the idea that, as long as farmers as well as those dealing with farm folks have the idea that many of our old farms are fully developed, progress will be slow; on the other hand, if we agencies, both governmental and commercial, could sell the idea of complete field reclamation, we might expect more satisfactory progress. Conditions seem to indicate that such progress is not affected by the continued existence or even increase in the number of subsistence farmers.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

A Study of Kerosene Cook Stoves, E. B. Snyder (Nebraska Station (Lincoln) Research Bulletin 48 (1930), pp. 44, figs. 6).—The results of studies of the advantages and disadvantages of 10 kerosene stoves having four types of burners are reported. These included 4 stoves having long-chimney wick burners, 3 stoves having short-chimney wick burners, 2 stoves having short chimneys with asbestos kindlers or lighting rings, and 1 stove having wickless burners.

To determine comparative speed of burners, equal quantities of water were heated through equal ranges of temperature. The tests were made by two methods, the "cold start," in which the time required to heat the water after the lighting of the cold burner was determined, and the "hot start," in which the time was determined with the burner fully heated at the beginning of the test. By the "cold start" method the average time required to heat the water by all long-chimney wick burners, adjusted as directed for maximum heat, was significantly less than averages for other types. The time required by one short-chimney burner studied was less than that of one long-chimney burner. The wickless burner required the longest to heat of the four types. By the "hot start" method the average time required to heat the water was approximately equal for burners with wicks. The average time required by burners with lighting rings and by wickless burners was greater than by those with wicks. The wickless required the longest time. Some differences in speed of heating of individual burners of the same type were greater than average differences for groups of different types. Giant burners required less time to heat the water than standard burners on the same stove. Burners covered with heavy grates required a longer time to heat the water than burners covered by open grates. Burners with wicks cooled more rapidly than other types. The wickless burners held heat longest.

To determine the comparative thermal efficiency of burners, equal amounts of water, at the same initial temperature, were completely evaporated, and the amount of kerosene used was determined. The average thermal efficiency of all long-chimney wick burners was lower than that of burners of other types. The average thermal efficiency of short-chimney wick burners was highest of the four types. One burner of the short-chimney lighting-ring type was higher in thermal efficiency than the average for short chimneys with wicks. The wickless burner was higher in thermal efficiency than long-chimney burners, but lower than the two remaining types. Standard burners were higher in thermal efficiency than giant burners on the same stove.

Long-chimney burners adjusted as directed by the manufacturer for maximum heat, that is, with yellow tips 1.5 inches above the blue flame, did not form soot on utensils. Other types of burners formed soot frequently. Because of the contact of the flame with the utensil, these burners are more likely to be affected by outside factors, causing scot to be formed.

To learn the effect of the size of utensil on the performance of burners, water was heated through equal ranges of temperature in pans of equal depth but varying in diameter. Giant and standard burners on the same stove were used for the tests. As the diameter of the pan increased the thermal efficiency increased, reaching a maximum at the largest pans, and as the diameter of the pan increased the time per pound required to heat it through a given range of temperature decreased, reaching a minimum at the largest pans. The practical significance of these results is that for every burner there is a definite size of utensil which can be used to best advantage. From the standpoint of economy of time and fuel, utensils should in general be fairly large.

To determine comparative cost of operation and time used for the cooking of food with different types of burners, a week's menus for six persons were cooked on four selected stoves, representing the different burner types. The burners were operated so as to use the minimum amount of time and oil. The long-chimney burner, over a week's time, used the greatest amount of kerosene. The short-chimney wick burner used the least kerosene of the four types. The total cost of operation, including wicks, lighting rings, and gasoline for priming the wickless burner, was highest for the long-chimney wick burner. For the wickless burner the total cost was slightly less than for the long-chimney wick burner. The total cost for the short-chimney with wick and the lighting-ring burners were lowest and approximately equal. The time required in burner hours was approximately equal for the long-chimney wick burner and the burner with lighting ring. The time required by the wickless burner was greatest of the 4 types. The burners with wicks were more quickly and easily adjusted for varying degrees of temperature for cooking purposes than were the other types of burners.

Installation of Motor-Driven Feed Grinders, T. E. Hienton (Indiana Station (La Fayette) Circular 173 (1930), pp. 4, figs. 4).—Practical information on the proper installation of motor-driven feed grinders is given in this circular.

[Agricultural Engineering Investigations at the Pennsylvania Station] (Pennsylvania Station (State College) Bulletin 258 (1930), pp. 13, 14).—An investigation, conducted by J. E. Nicholas and R. U. Blasingame on about 38 different farms in various parts of the state, showed that there were as many different types of electric milk refrigerating machine installations as there were farms visited. Tests made on more than half of these indicate that no two machines gave the same results, varying from 4 to 26 gallons of milk cooled per kilowatt-hour. It was found that agitation of the water in the cooling vat increases the rate of cooling.

Tests of a continuous feed grinding and mixing plant indicated that a ton of any required ration can be made in less than four hours, with an approximate power consumption of 15.5 kilowatt-hours. The time and power required depend largely on the ration of mix required and the fineness of the grain ground. Both the common 4-ply flat canvass belt and a V-type cog belt were used to drive the mill.

In tests of accessories for use with tractors in plowing stony soils, made by H. B. Josephson and Blasingame, a track-type tractor and a subsoiler were employed with success for removing stones which interfere with plowing. Rock ledges were dynamited, then pulled. A quick coupling hitch spring release was adapted to plowing in stony ground.

Effectiveness of Moisture-Excluding Coatings on Wood, G. M. Hunt (U. S. Department of Agriculture Circular 128 (1930), pp. 28, figs. 8).—This circular brings together the results of various experiments made at the Forest Products Laboratory by different investigators on the moisture proofing of wood by coatings and impregnation treatments.

No method or material has yet been discovered which will completely prevent moisture changes in wood, but it has been found practical, by the use of suitable coatings, to reduce the rate of moisture absorption very materially and thus reduce, if not entirely eliminate, some of the troubles due to moisture changes.

The most effective moisture-resistant coatings found for wood were those containing aluminum leaf between coats of other materials such as paint, varnish, or the like. For exterior exposure linseed oil paint was found very effective for use with the aluminum leaf because it stood up well under weathering. For interior use with the leaf either varnishes, enamels, or paints were found suitable. Coatings of varnish, enamel, or paint containing aluminum powder were next in effectiveness to aluminum-leaf coatings. Such coatings, when properly applied and maintained, reduced the rate of moisture change in wood so that when exposed to practically saturated air for two weeks only about 5 to 10 per cent as much moisture entered the coated wood as entered similar wood uncoated. Good paints of the linseed oil, bituminous, or asphaltic type, containing aluminum powder, maintained their effectiveness throughout long periods of exposure to the weather. Some of the best coatings of the linseed oil-aluminum powder type maintained better than 90 per cent effectiveness after more than two years' exposure to the weather. The moisture-excluding effectiveness of red lead and orange mineral pigment paints increased notably with increasing percentage of pigment, and a still further increase was effected by the addition of aluminum powder.

Of the many asphaltic, bituminous and similar paints tested, a few were very effective. Spar varnishes were found moderately effective in retarding moisture changes. Wood properly dried and then varnished on all sides fluctuated much less in moisture content under changing atmospheric conditions than unvarnished wood. In using spar varnishes, increasing effectiveness was observed as the number of coats increased. Dipped coatings were more effective than brushed coatings. Oven-dried coatings were similar in effectiveness to air-dried coatings. The addition of pigments to varnishes made them more effective. Varnishes made with artificial resins of the bakelite type appeared to be superior in moisture-excluding effectiveness to ordinary spar varnishes, but generalizations concerning the artificial resin varnishes tested are not dependable since their composition was not known. High effectiveness was found in a proprietary paint said to contain a lead suboxide as its principal pigment.

Thorough impregnation with sugar, while ineffective in preventing moisture changes, greatly reduced dimension changes with changing moisture content. The moisture-excluding effectiveness of impregnation treatments as compared with coatings was not adequately studied, but the indications are that deep impregnation is not so necessary as a continuous film over the surface. Coatings or treatments with linseed oil, floor wax and the like, were low in effectiveness.

Why Some Wood Surfaces Hold Paint Longer Than Others, F. L. Browne, (U. S. Department of Agriculture Leaflet 62 (1930), pp. 4, figs. 3).—Practical information is given on painting, especially on selecting the kinds of wood that hold paint coatings most satisfactorily. It is pointed out that the density, or weight per unit volume, of a softwood board measures roughly its ability to hold paint coatings because boards are heavy or light according as they contain much or little summer wood.

Surface Irrigation in the Eastern States, F. E. Staebner (U. S. Department of Agriculture, Farmers' Bulletin 1635 (1930), pp. II + 38, figs. 25).—This bulletin supersedes Farmers' Bulletin 899. It gives practical information on surface irrigation with special reference to its use in the agriculture of the states.

Water Survey of Texas County, Oklahoma, H. W. Houghton ([Stillwater, Oklahoma] Panhandle Station, Panhandle Bulletin 20 (1930), pp. 30, fig. 1).—A survey of the waters from 75 wells of the county is reported, including the results of chemical analyses. The water levels found in the county appear to be very uniform throughout, varying from very deep wells in the western part to shallower wells in the eastern part. Also, in most cases, the wells are deeper in the northern parts of the county than in the southern part. The water sands generally keep their relative positions throughout the county with a few breaks in the region of the Paloduro.

It is certain that the water can not arrive at these depths by merely penetrating the soil as the clay formations and rock formations beneath the soil and above the water are practically impervious to water. It is conjectured that much of this water passes into the water sands from the watershed as it comes from the mountain regions to the west. Also, it is thought that much of it arrives in the water sands from the large rivers due to rains and snows. Apparently the existence of sheet water was not established.

Fighting the Corn Borer with Machinery in the Two-Generation Area, C. O. Reed, R. B. Gray, L. H. Worthley, and D. J. Caffrey (U. S. Department of Agriculture Circular 132 (1930), pp. 50, figs. 36).—This is a contribution from the U. S. D. A. Bureaus of Public Roads and Entomology, the Plant Quarantine and Control Administration, and Ohio State University. It gives practical information on corn borer control with machinery in areas where the corn borer passes two generations annually.

Grain Drying at a Country Elevator, W. M. Hurst and R. H. Black (U. S. Department of Agriculture Circular 127 (1930), pp. 15, figs. 4).—A general discussion of the moisture content of grain and the need for grain driers is followed by a brief description of a commercial grain drier, by data on its cost of operation, and by data from moisture, test weight and dockage determinations. Data on the increase in market value of wheat due to drying are also included.

Farm Bulk Storage for Small Grains, M. A. R. Kelley and E. G. Boerner (U. S. Department of Agriculture, Farmers' Bulletin 1636 (1930), pp. II + 46, figs. 51).—This bulletin explains the losses in grain due to the faulty construction of storages, and gives practical information on better building methods. Designs for several types of storages for small grains adapted to wheat belt conditions are also presented.

A Maize Stalk Shredder, H. J. Hopfen (International Review of Agriculture, Monthly Bulletin, Agricultural Science and Practice [Rome], 21 (1930), No. 3, pp. 100, 101, figs. 3).—A machine which shreds and defibrates cornstalks for feed is briefly described, based upon the results of experiments conducted in Hungary. It consists essentially of a cylinder and concave. The cylinder consists of a central shaft with four disks connected by crosspieces between which are the lacerating teeth. The inside diameter is 61 centimeters (24 inches), the width 107 centimeters, and the speed 1,130 rpm.

The best results are obtained by treating the stalks as soon as possible after cropping, while they still retain their moisture. The corn borer is thus effectively controlled because the larvae are killed either during shredding or during acidification in the silo afterwards. In addition to cornstalks, gourds, potatoes, fodder beet and sugar beet tops and roots can be cut up for silage.

The Relation of Environmental Conditions in Poultry Houses to Winter Egg Production, C. W. Smith (Nebraska Station (Lincoln) Bulletin 247 (1930), pp. 34, figs. 17).—Studies, covering 7 seasons and involving 4,527 hens, are reported on the effect of temperature, humidity, ventilation and artificial light on winter egg production.

Insulation had a beneficial effect on winter egg production. The uninsulated check house was always low in egg production in January and February. Closing a house up tightly all night during the winter season had no detrimental effect on winter egg production. While this procedure showed no merits that would warrant its being recommended for general practice, it did show that hens can thrive in an environment where there is very little air change. Steam-heated radiators, when used to keep a minimum temperature of 50 degrees F in poultry houses, increased egg production in December, January, and February. A smaller increase was produced in December than in the latter months. The hens in the heated houses slumped during March, when their production fell slightly below that of the hens in the unheated houses.

The use of a small stove to lower the humidity but not to raise the temperature appreciably proved to be of doubtful value as measured by winter egg production. No correlation was found between humidity and winter egg production.

There was no advantage in the use of a commercial ventilator on a heated house, and apparently only slight advantage in its use on an unheated house. The results over 2 seasons and involving 4 houses and 740 hens indicate that the use of a commercial ventilator will not increase winter egg production sufficiently to pay for the ventilator and its installation. An electric fan for stirring the air, operated in one of the heated houses for 3 seasons; produced no results warranting installation. An exhaust fan, which moved large quantities of air from one heated unit the last 3 seasons of the experiment, produced no results warranting its installation. Muslin-covered transoms offset much of the advantage gained by insulation. They permit but little air change. Artificial lighting is a very potent factor in increasing egg production in the winter. One unheated and uninsulated house was artificially lighted 2 seasons before lights were installed in all houses. During those 2 seasons its production exceeded that of any other house.

The Principles of Underdrainage, R. D. Walker (London: Chapman & Hall, 1929, pp. XXIV + 223, pls. [14], figs. 70).—This book deals with the broad principles of underdrainage in its various branches. "It has been prepared with the aim of placing an engineer in possession of facts which should enable him to design satisfactory underdrainage, each design being treated on its own merits and due allowance being made for the various factors involved."

Chapters are included on definitions and principles, underground waters, the theory and uses of underdrainage, underdrains and their location, antimalaria drainage and its objects, the underdrainage of ravines, the underdrainage of flat lands, the underdrainage of land underlain by shale, the drainage of cuttings by means of pipe underdrains, underdrainage for the prevention of slips and subsidences, the economics of underdrainage, underdrainage estimates, construction of pipe underdrains, the maintenance of underdrains, open drains and their uses, maximum flood discharges, and the flow in pipe underdrains. Five appendixes are included relating to notes on clay, capacity charts for pipe underdrainage, identification of Anopheline and Culex mosquitoes, water requirements of agricultural land, and schedule of rates for underdrainage and allied works in operation in Kuala Lumpur, F. M. S., in 1928.

[Tile Drainage Investigations on the Trumbull County Experiment Farm in Ohio] (Ohio Station (Wooster) County Experiment Farms Annual Reports 1929, Trumbull Co. Farm, pp. 1-3).—The results of 11 years' drainage work on the farm are briefly summarized, indicating that on the heavy soils of Trumbull County there has been no gain in laying the tile much deeper than 18 inches. In fact, putting them deeper has resulted in slightly lower yields.

The wheat crop showed the greatest increase in yield as the result of tile. As regards silage corn, oats and mixed hay, the results apparently must be interpreted as quite favorable to the possibilities of growing fair yields without tile. The oat crop has consistently shown an increase from tile, but the money value of such increase with oats at 50 cents a bushel is not large.

The South Dakota Poultry House, R. L. Patty (South Dakota Agricultural College (Brookings) Extension Circular 295 (1930), pp. 16, figs. 10).—A brief description is given of the plan of this poultry house.

Electricity for Poultry Raising, H. E. Lacy, Georgia Agricultural College (Athens) Bulletin 391 (1930), pp. 24, figs. 11).—Practical information is presented on the use of electricity for lighting laying houses, incubation, brooding, feed grinding and mixing, and water heating.

The Mechanical Corn Picker in Ohio, J. H. Sitterley (Ohio Station (Wooster) Bimonthly Bulletin 146 (1930), pp. 168, 169).—The results of a survey of the use of the mechanical corn picker by 65 Ohio farmers during 1929 are briefly presented, indicating that harvesting costs can be reduced by its use, although it is wasteful of corn and can not be used in wet weather.

[Poultry House Investigations at the Ohio Station], D. C. Kennard and V. D. Chamberlin (Ohio Station (Wooster) Bimonthly Bulletin 146 (1930), pp. 135-144, figs. 7).—A description is given of the new laying house recently added to the station poultry plant.

The Farm Shop, L. J. Smith and H. L. Garver (Washington College Station (Pullman) Popular Bulletin 147 (1930), pp. 24, figs. 8).—This popular report is a contribution from the station and the Washington Committee on the Relation of Electricity to Agriculture. It gives practical information on the organization and management of the farm shop using electricity as a source of energy.

[Agricultural Engineering Investigations at the North Dakota Station], R. C. Miller (North Dakota Station (Fargo) Bulletin 233 (1930), pp. 61-65, figs. 2).—Tests of grain drills and beet

planters for planting corn showed that grain drills, both fluted and internal double-feed type of force feeds, will plant a uniform quantity of corn per acre but that they do not space the kernels a uniform distance. The double-run internal feed showed somewhat more accurate adjustment as to quantity per acre, but in uniformity of spacing of kernels the test results indicated no choice. All the drills tested showed a great variation in spacing of kernels. Beet drills tested with smallest beet seed plate and slowest speed planted thickly enough, 8.1 inches average, and had slightly more uniform spacing than the grain drills. The beet drill can plant as efficiently as a corn planter if special corn plates are used. Tests with a corn planter showed that it was more efficient in drilling corn, 90 per cent of the kernels being spaced between 7 and 8 inches apart. The only cracking of kernels that was noticeable in all tests conducted was when the small side of a double-run internal-feed grain drill was used.

Tests of the power requirements of various types of farm machines showed that the four-bottom plow required relatively more power than the three-bottom plow. This was due in part to the subsurface packer pulled in tandem, which required approximately 300 pounds draft. From all draft tests it is evident that at quite uniform depths in the same field there will be a draft variation due to soil varieties and characteristics. Moist, firm sandy loam in low ground will naturally require more draft than a drier, loose sandy loam on high ground. Draft increases directly as the depth is increased. Tabular data on power requirements for plowing are included.

Data also are reported on grain drying and on tests of the pulverator.

Annual Report of the Department of Sewage Disposal for the Year Ending June 30, 1929, W. Rudolfs (New Jersey Stations (New Brunswick) Bulletin 502 (1930), pp. 40, figs. 16).—This report contains among other things data on the performance of several sewage disposal plants and reports the results of certain specific investigations.

Studies by W. H. Baumgartner on the effect of certain chemicals on the vacuum filtration and gravity drying of ripe sludge showed that ferric chloride is the most effective treating chemical for ripe sludge. It has a threefold effect in sludge drying and filtration; namely, discharge of the dispersed material, causing coalescence; change of the hydrogen-ion concentration, thus approaching the isoelectric points where maximum precipitation of the colloidal material takes place; and finally, liberation of carbon dioxide, making the material porous and helping in its flotation. There are peaks in the filtration of ferric-chloride-treated sludge which correspond to definite pH values. These peaks are at concentrations of 2 and 7 pounds to the cubic yard of sludge, respectively. Ferric chloride increases the amount of drainage from sludge drying on beds and thus decreases the time for evaporation. Treated sludge has a porous nature which allows more surface for evaporation. Moisture is removed more rapidly by treating ripe sludge with ferric chloride.

Studies by Rudolfs and I. O. Lacy, dealing with the relation between drainage and evaporation of drying sludge, indicated that up to a temperature of 130 F drainage is a more important factor than evaporation. Evidently, covering sludge beds with greenhouses is most important from the standpoint of keeping rains off the beds, unless the greenhouses are heated to a comparatively high degree and the evaporating moisture is removed.

According to the results of studies by A. J. Fischer, drying of fresh solids in the open is not feasible when treated with lime, alum, or a mixture of lime and alum on account of poor drainage, objectionable odors, or both.

Studies by H. Heukelekian on certain organic constituents of fresh and ripe sewage sludge showed that the most abundant constituents of the organic matter of fresh solids are fats and crude proteins. Materials present in smaller percentages are water-soluble and alcohol-soluble substances, hemicellulose, cellulose, and lignin. Of these constituents fats and cellulose show the greatest decrease in the ripe sludge. Resistant substances like waxes and lignin included in the alcohol-soluble fraction, are not decomposed readily and are therefore present in the ripe sludge in larger percentages than in the fresh solids.

Combining Grain in Weed-Free Fields, D. E. Wiant and R. L. Patty (South Dakota Station (Brookings) Bulletin 251 (1930), pp. 11, figs. 5).—This is a progress report for the year 1929 of the study of combining practices, the work being done in a weed-free field.

It was found that windrowing could be begun as early as 8 a.m. in a clean field. In windrowing clean grain a wide swath which made a heavy windrow was not objectionable as far as the drying out of the grain was concerned. The losses for straight combining and also for windrow harvesting in clean grain were less than the average binder-separator losses of the present-day methods of harvesting. There was less loss when picking up at 2 miles per hour than when picking up at 3 miles per hour. When the windrow was picked up at a rate so fast as to tear it apart more grain was shattered and lost on the ground. A combine pulled at approximately 2 miles per hour threshed a swath 4 to 6 feet wider than its cutting width without excessive loss in a field yielding 52 bushels per acre. When the rate of travel was increased or the width of swath increased the losses were increased, both as to shattering losses and the threshing losses.

A fairly heavy windrow stayed in good condition for a month regardless of ordinary rains, while a light windrow worked down through the stubble and the grain started to grow within two weeks' time. Oats could have been direct combined any time from July 26 to August 9 without excessive loss. A study of the weed-free field would indicate that in such a field the windrowing method of harvesting is unnecessary and that direct combining of clean fields is an entirely satisfactory practice. It would indicate that green weed tips and green growth in the stubble bottom is responsible for even more of the moisture in grain that is combined direct than was anticipated.

Ventilation of Farm Barns, M. A. R. Kelley (U. S. Department of Agriculture, Technical Bulletin 187 (1930), pp. 75, pls. 8, figs. 24).—The results of investigations, conducted by the U.S.D.A. Bureau of Public Roads in cooperation with the American Society of Agricultural Engineers and several State agricultural experiment stations, are reported. Altogether 27 tests were made, 3 in horse barns, 1 in a hog house, 5 in barns with mixed stock, and 18 in dairy barns. Five tests were made in North Dakota, 6 in Minnesota, 1 in South Dakota, 3 in the Upper Peninsula and 2 in the Lower Peninsula of Michigan, 2 in Massachusetts, 1 in Maine, and 7 in New York State. The tests were made in the localities indicated for the reason that the ventilation problem is of greater importance in cold sections than where winters are comparatively mild, both because of the atmospheric conditions and because the greater portion of the dairy cows of the country are located in the northern and northeastern states.

Most of the tests were made in barns where the principles of the King system of ventilation were employed. Three tests were made in barns in which windows are used for intakes, that is, the Sheringham valve principle, 4 tests in barns equipped with a modified King system, and 1 test in a barn in which a fan system of ventilation was installed. Most of the barns were of frame construction with varying degrees of insulation. Concrete blocks were used in the construction of the walls in three barns.

The results showed that carbon dioxide as ordinarily encountered in stable air does not settle. The evil effects of bad ventilation are not caused by carbon dioxide as found in the average stable. There must be a constant removal of moisture from the occupied stable or the amount of moisture in the air will increase. Damp walls may be due to improper ventilation, poor construction, or insufficient production of heat or lack of conservation of heat. A large volume of air space per head is not a substitute for ventilation, as purity of air is not dependent upon volume of air space. However, the volume allowance per head is important with regard to maintenance of stable temperature and varies according to climatic conditions.

Insulation requirements vary according to the temperatures to be expected in the different sections, amount of air space which the animal must heat, the amount of ventilation desired, and the method of securing it. The amount and choice of insulating material required will depend upon the relative efficiency and cost of the various materials available. Tight construction to prevent excessive leakage of air is essential to effective insulation. Whenever barn walls are tightly built to save heat, ventilation becomes necessary. Storm sash, storm doors, vestibules, and feed rooms may be used as effective forms of protection against cold.

It is possible to maintain a comfortable temperature in a well-built barn and yet have an appreciable circulation of air. The temperature in a stable filled with stock can be controlled by temporarily or partly closing the ventilation system. Stable temperatures within certain limits appear to affect both the quantity and quality of milk. Wind velocity and direction have an effect upon the amount of ventilation. Back drafting may be due to poor design or poor position of ventilator or intake. Outtakes near the floor are more favorable to the maintenance of desirable stable temperature than ceiling openings. Under average conditions outside temperature is usually the dominant factor in barn ventilation. The moisture-content of the air in a well-built stable is usually controlled by the amount of ventilation.

Horizontal runs and abrupt turns in outtake flues should be avoided. An air-tight flue with proper insulation is necessary to greatest efficiency. Lack of insulation may cause excessive drip from flues. This factor should be given consideration especially in the northern zone. The bases of ventilator heads should be equipped with suitable doors, which may be opened or closed as required. The efficiency of an outtake flue is affected by an open base. Windows as intakes require frequent adjustment and prevent uniform regulation of the ventilation. Their use for such purpose is undesirable in cold sections. However, during mild weather they are an advantage as they provide a large area of opening. Warm-air furnace registers are unsuitable for use as intake valves in barn ventilation. Open hay chutes interfere with ventilation and should not be used as foul air shafts.

A formula is developed from which flue sizes proportioned to local temperatures may be obtained. In this formula

$$A = \frac{163 + 1.6\,t_o}{\sqrt{H}}$$

A is the flue area for any outside temperature t_o, and **H** is the flue height.

A list of 47 references to literature bearing on the subject is included.

AGRICULTURAL ENGINEERING

Established 1920

A journal devoted to the advancement of the theory and practice of engineering as applied to agriculture and of the allied arts and sciences. Published monthly by the American Society of Agricultural Engineers, under the direction of the Publications Committee.

PUBLICATIONS COMMITTEE

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The Society is not responsible for the statements and opinions contained in the papers and discussions published in this journal. They represent the views of the individuals to whom they are credited and are not binding on the Society as a whole.

Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

Raymond Olney, Editor

R. A. Palmer, Associate Editor

"Let Us Now Be Up . . ."

AGRICULTURE has always needed engineering, but there is today a most urgent need for clear, analytical thinking based on proven facts and sound judgment.

Agriculture today is not only ready to accept a change, but is convinced that a change must come.

The character of engineering leadership afforded agriculture during the next few years will to a great extent determine the future course of this great industry.

The American Society of Agricultural Engineers is a most unusual organization. It is unusual for the large percentage of its membership annually attending its various meetings. It is a hard-working Society. Its members are intensely proud of the accomplishments of their Society.

Many ASAE members are giving serious thought as to what should be the proper functions of their Society. Undoubtedly, the interests of the individual member properly may extend considerably beyond the proper confines of the interests and actions of the Society. It is not possible to include in the programs of our meetings a range of subjects adequate to include all the interests of all of our individual members, and if it were possible it would not be advisable. There are some, however, who would confine the attention of the Society to the relatively narrow field of the application of materials and energy to the needs of agriculture. However, the engineer today certainly is justified in making careful studies also of the engineering requirements of the industry he serves and the economics of the application of the devices or methods he proposes or produces. It should be the function, therefore, of the ASAE, through its publications, meetings and committee work, to furnish a common ground, or vehicle, for agricultural engineering data and expression. Individual members may, most certainly, speak for themselves, but the Society carefully guards its official statements.

Some members look upon committee appointments as mainly a recognition of their knowledge or activity in a certain field. It is the plan this year to make the results of committee activity the basis of meetings papers and discussions. Division and committee chairmen are making every effort to see that the most important problems are receiving attention, while not neglecting more fundamental or basic work on which future agricultural practices will be built. Each committee should assume the responsibility of making a thorough study of its subject, selecting the phase or phases which are to be especially studied, and then act as the editorial committee on the paper which arises from the completion of their activities.

An engineer is traditionally modest concerning his ability, and prefers to wait until the client for information knocks at his door. The present situation, however, demands aggressiveness on the part of the agricultural engineer. No individual or group will completely solve the present complex agricultural problem, but through the combined efforts of everyone who can contribute, rapid and definite progress is sure to result. Practically every solution to the present situation has a prominent engineering phase; for example, increasing yields per acre, improving the quality of farm products, reducing per acre costs, utilizing of agricultural by-products, increasing the "non-stomach" use of farm crops, better utilization of land, erosion control, reducing transportation costs, together with the wider social problems of rural housing and better living — all of these call for the engineer.

It is time for action. The agricultural engineer is over the top. Where in the past we have waited to express our opinions until we were closeted with our colleagues, we must now face the situation and stay by our guns. With facts and proven opinions for ammunition and aiming at a better engineered agriculture, the members of the American Society of Agricultural Engineers are among the shock troops which are starting agriculture along the road of new accomplishments and sure progress.—L. J. FLETCHER, President, ASAE.

Petroleum, Exploitation, Overproduction and Control

WHEELER McMILLEN[1] keen lookout for agriculture in its voyage over treacherous economic seas, has spied a pirate ship approaching, flying the false colors of protection for American interests. His warning cry is published in a bulletin, entitled "The Farmers' Stake in the Proposed Tariff on Oil." Because of the threat of this impending tariff to the increasing application of engineering to agriculture, this presentation warrants reading by every agricultural engineer.

Briefly, according to Mr. McMillen and others whom he quotes, the big U.S.-owned domestic petroleum industry is collecting money and planning a program to subtly persuade the next Congress that it needs protection from its little brother, the U. S.-owned foreign petroleum industry, in the form of a prohibitive import tariff. What it asks, in effect, is that a large U. S. industry be subsidized, to the practical extinction of a smaller U. S. industry and at a cost to U. S. farmers and other oil consumers all out of proportion to the benefits to this large industry, so that it can continue to profit by its wanton exploitation of one of the nation's important exhaustible natural resources.

Every question is supposed to have two sides and we are frank to say that we have not yet heard the other side of this one. We realize, however, that the individuals involved in the ownership and management of the U. S. domestic petroleum industry are not pirates but civilized human beings with normal motives, apparently caught in an economic trap and trying desperately to extricate themselves.

Others have been caught in the same trap. Even farmers! In the rise of civilization there have been many cases in which the free, uncontrolled competitive industry of individuals and individual corporations has not worked out to the best interests of those individuals, of their group or of society as a whole. It has killed their own game, individually and collectively, and has resulted in loss to society. This is particularly true where it involves the exploitation, for immediate private profit, of natural resources which are exhaustible or which are replenished by nature only slowly. Individualism is a busy promoter but

[1]Associate editor, "The Country Home." Aff. Mem. A.S.A.E.

a careless custodian. And when competition in the development of these resources becomes a race for flash-in-the-pan profits, watch out. That is a danger sign. That sort of competition killed off our buffalo and levelled the best of our forests. It is keeping many farmers so busy keeping two jumps ahead of the sheriff that they have no time or money to protect their soil against erosion, to say nothing about improving it. And now it threatens our oil supply.

Every time an industry starts working its own destruction in this way someone suggests some scheme for voluntary restriction of production. But these schemes always fail because everyone can see that his production is just a drop in the bucket of the total, and that it is to his own advantage to produce all he can, especially in view of promised higher prices. Human nature being what it is, individual producers have greater faith in profits arising from their own activity than from a benevolent reduction of activity by their competitors.

Other solutions have been tried and are being tried. The problem will never be solved until group authority forcibly throttles American individualism, which creates it. Individual rights have been set aside for the common good before—in game laws, in zoning restrictions and in condemnation proceedings. If the Interstate Commerce Commission has not now the power to guard the interests of future generations as zealously as it wields the Sherman Anti-Trust Law in behalf of the present American public, the authority should be invested either in that or some other body. The federal government should step down hard on, rather than boost, the tendency of the domestic petroleum industry to kill itself by exhausting its stock-in-trade as rapidly as possible for the sake of cash-in-hand.

Obsolescence of Farm Equipment

WHERE farming has been a matter of earning an existence by raising whatever could be raised on a few acres with the aid of a few simple hand and one or two-horse tools, the practice has been, and probably always will be, to make equipment last as long as possible before thinking of replacing it. Likewise the buying of "new-fangled" equipment for such farms has been conditioned by the farmer's state of mind and pocketbook, the effectiveness of the sales methods used on him and the appearance of the new machine.

Many farmers who have otherwise modernized their methods and are producing on a commercial basis have held to their "baling wire economics" of getting the utmost service out of each individual machine before discarding it, whatever might be the cost in wasted time and neglected opportunities.

For those who depend largely on equipment to produce their wages or profits, and whose equipment investment has run up from hundreds into thousands of dollars, this "baling wire economics" is no longer adequate or satisfactory. Large production equipment investments, on the farm as well as elsewhere, can be made intelligently only when based on the economics of production and of obsolescence. To get down to cases we cite some views on obsolescence current among the production engineers of the machine-tool and automotive industries[1],—two industries which are leaders in the study and practical applications of the subject.

Obsolescence relates to the economic value of any unit of equipment in a production program. It is a matter of relative earning capacity as influenced by changes in market demand for the product of the equipment and by the development of improved equipment which will do the same work more efficiently. It is a part of the cost of progress, and cannot be dodged, though it may remain unrecognized. It cannot be definitely predicated but should be calculated and allowed for. Obsolescence should not be confused or figured in costs with depreciation, which relates to the physical condition of equipment, or with amortization, which relates to the repayment of its cost.

Controlling factors in the obsolescence of equipment are (1) its efficiency in competition with improved equipment for doing the same work better or cheaper, (2) its adaptability for economic service, considering changes in product or processing which may eliminate it or reduce its efficiency below that of other machinery, (3) its relative efficiency under more stringent requirements of any kind, such as increased accuracy, and (4) the quantitative factor, or the unit saving possible by a change of equipment multiplied by the number of units to be produced. There are also other factors which exert an important influence on obsolescence, such as stability of the product; growth of the producing organization or of the market for its products as they affect production methods; flexibility and adaptability of single-purpose machines; the trend of consumer demand; and activity in research, development and standardization in general, and particularly by manufacturers of machines used in the operations in question.

The U. S. Department of Commerce is studying obsolescence. Together with some of the industries it recognizes the need of a distinct method of providing against obsolescence as a hazard of business. The best suggestion that has come to light so far is that the probable economic life of equipment be calculated from an actuarial standpoint.

To determine whether or not a given piece of equipment has lived out its economic life and should be scrapped, it is necessary to determine whether or not the savings affected by the new equipment will pay for it during its economic life. This is determined by dividing the net investment by the estimated annual savings, giving the years in which it will pay for itself. Some twenty-five or thirty formulas to express this relationship, based on different combinations of net investment and annual savings factors, have been developed. None of these, however, can be more accurate than the cost accounting data to which they may be applied. Neither can they take the place of keen managerial ability and up-to-date knowledge of the available facilities for economical production.

We do not have to look far in agriculture to find cases of obsolescence. There is the case of the combine and the binder in some parts of the country. There is the shift from sack to bulk handling of small grains, from one to two, three and four-row machines, from horse to tractor power, from ground to power take-off drives, from portable to pipe-line sprayers, and so on through the whole line of farm operating equipment.

That these changes are taking place and that serviceable equipment is being disposed of as obsolete is no cause for regret. But that they are having to be made by guess, and by slow, costly, cut and try methods is regrettable. Only in a comparatively few cases is the advisability of any proposed change of equipment so obvious to a farmer that he can make it immediately and with assurance, even after he has obtained reliable data on the performance and capacity of the proposed new equipment. The country-wide shift to increasingly modern and efficient farm equipment is the resultant of individual farmers making specific changes in items of their equipment on rough estimation of the economy of so doing at that particular time. And it is a safe bet that of the changes thus made many are made too late, some too soon, and some to the wrong kind of equipment for the greatest financial advantage of the farmers concerned.

This is an unnecessary condition and involves waste which we should minimize by studying and advancing the efficient application and replacement of our inherently efficient equipment, following the economics of production and obsolescence as they apply in agriculture.

[1] "Controlling Factors in Machine Tool Obsolescence" by L. A. Blackburn, "S.A.E. Journal," Vol. XXVIII, No. 4 (April, 1931).

A.S.A.E. and Related Activities

J. T. Jardine to Head Office of Experiment Stations

SECRETARY Hyde of the U. S. Department of Agriculture recently named James T. Jardine as Chief of the Office of Experiment Stations. This post has been vacant since the death of the former chief, Dr. E. W. Allen, more than a year ago.

Mr. Jardine is a brother of former secretary of agriculture, W. M. Jardine. He is a graduate of Utah Agricultural College, was for a number of years in the U. S. Forest Service; and brings to his new position the benefit of experience since 1920 as director of the Oregon Agricultural Experiment Station. He has also served the government on special missions, including a study of the agricultural situation in Alaska and a survey of the work of the land-grant experiment stations. He is an enthusiastic advocate of rural electrification.

As Chief of the Office of Experiment Stations Mr. Jardine will have charge of the correlation of research in 53 experiment stations which are carrying forward some 9,500 projects. He will also be assistant director of the Department's scientific work and as such will help to correlate research projects within the Department.

Mr. Jardine will take over his new work about the middle of September.

ASAE Meetings

North Atlantic Section—at Rutgers University, New Brunswick, New Jersey, Thursday and Friday, October 15 and 16.

Power and Machinery Division—at the Stevens Hotel, Chicago, Ill., Monday and Tuesday, November 30 and December 1.

Structures Division—at the Stevens Hotel, Chicago, Ill., Tuesday and Wednesday, December 1 and 2.

Reclamation Division — at the Stevens Hotel, Chicago, Ill., Wednesday and Thursday, December 2 and 3 (Tentative).

Southern Section — at Birmingham, Alabama, February 3, 4 and 5, 1932.

Necrology

Elmer Johnson, senior agricultural engineer, U.S.D.A. Bureau of Agricultural Engineering, died suddenly in his apartment in Washington on July 28, of a heart attack. He had been in the agricultural engineering work of the Department of Agriculture since 1914 and a member of A.S.A.E. since 1919. Much of his work was done at the Delta Laboratory of the Department at Tallulah, Louisiana. He had made extensive studies of equipment for applying insecticides to field crops, including airplane cotton dusting equipment. At the time of his death he was in Washington preparing to make an investigation of sugar cane harvesting machinery. He was 49 years old and is survived by his father, mother and sister.

Personals of ASAE Members

Hobart Beresford, agricultural engineer, Idaho Agricultural Experiment Station, and secretary and project director, Idaho Committee on the Relation of Electricity to Agriculture, is author of Idaho Agricultural Experiment Station Bulletin No. 180 entitled "Rural Electrification Development in Idaho."

M. C. Betts, senior architect and **M. A. R. Kelley,** associate agricultural engineer, U.S.D.A. Bureau of Agricultural Engineering, are joint authors of U.S.D.A. Circular No. 166, entitled "Suggestions for the Improvement of Old Bank Dairy Barns."

J. B. Kelley, professor of agricultural engineering, University of Kentucky, is author of Extension Circular No. 128 (Revised), of that institution, entitled "Building Plans for the Dairy Farm."

W. H. McPheeters has been appointed to take charge of agricultural engineering work at Connecticut Agricultural College at Storrs, and will devote half of his time to teaching and the other half to extension work in agricultural engineering. He was at one time extension agricultural engineer at Oklahoma A & M College and more recently a field engineer of the Portland Cement Association.

J. E. Newman, of the Institute of Agricultural Engineering, University of Oxford, is one of the authors of the British Ministry of Agriculture and Fisheries' Bulletin No. 27, entitled "The Use of Agricultural Machinery in Canada and the United States of America." This is the official publication of the report made early in the year by the British commission, including Mr. Newman, which visited North America last year to determine what American methods involving the extensive use of machinery might be of possible value to British agriculture.

Chas. E. Seitz, professor of agricultural engineering, and **Verne R. Hillman,** assistant agricultural engineer, Virginia Polytechnic Institute, are authors of Virginia Agricultural Extension Bulletin No. 122, entitled "Rural Electrification in Virginia."

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the May issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Charles A. Matthews, field representative and educational work, American Zinc Institute, New York City.

Robert Millinchamp, assistant and lecturer in agricultural engineering, Macdonald College of McGill University, Macdonald College, P.Q., Canada.

Charles E. Watson, salesman, Aluminum Company of America, Kansas City, Mo.

New ASAE Members

James Carl Archer, agent and farmforeman, U. S. Dept. of Agriculture, Bureau of Public Roads, Lindale, Tex.

George C. Bartelle, field representative, American Zinc Institute, 60 E. 42nd St., New York City. Mail address: 806 Cedar St., Collinsville, Ill.

Mark B. Kulp, department of agricultural engineering, University of Idaho, Moscow, Idaho.

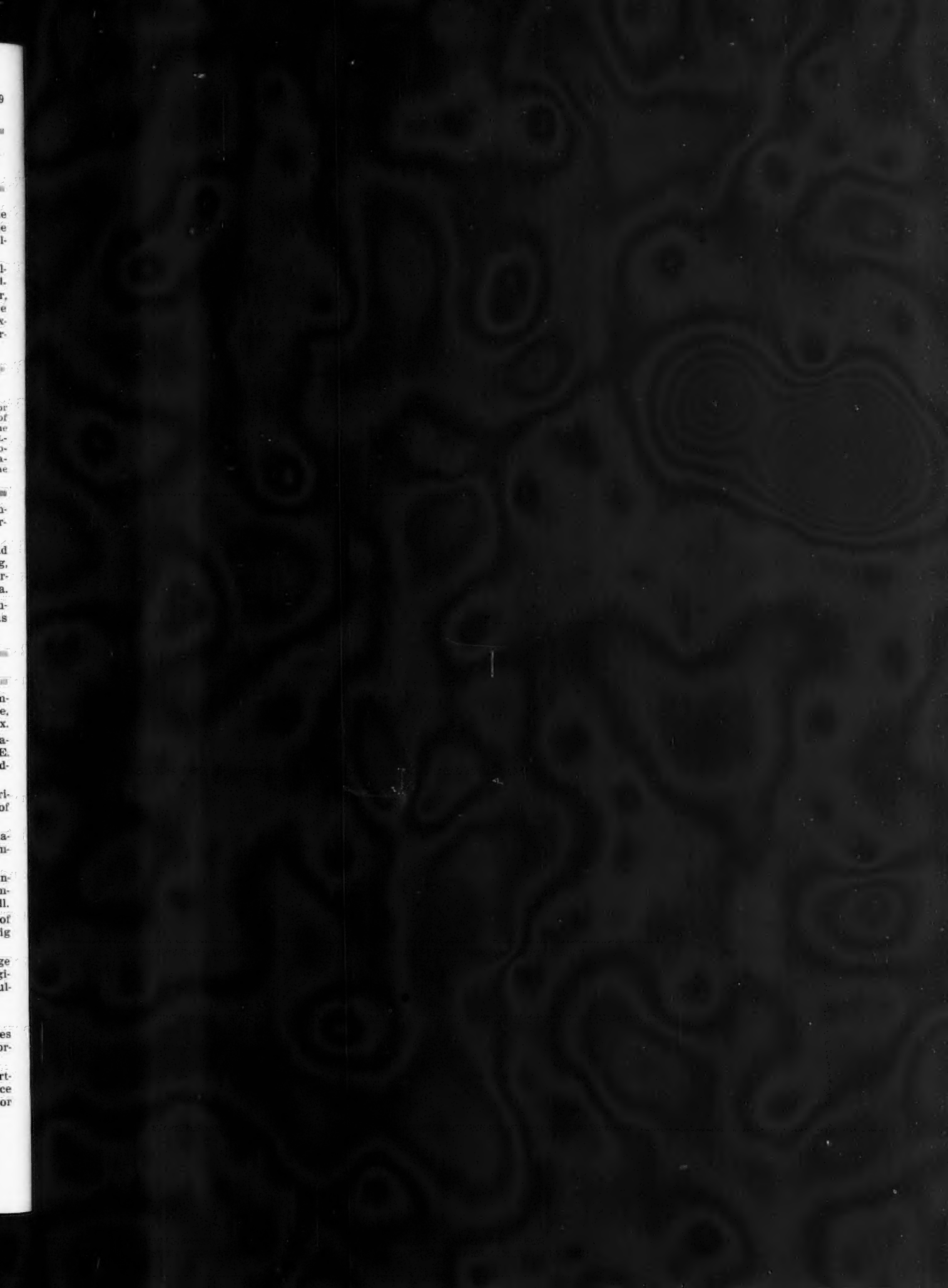
George R. Mellema, director ventilation division, Clay Equipment Company, Cedar Falls, Iowa.

Gust Olson, Jr., general works manager, Oliver Farm Equipment Company, 400 W. Madison St., Chicago, Ill.

Hans Sack, technical manager of Rud. Sack Implement Works, Leipsig W-31, Germany.

David L. Yarnell, senior drainage engineer, Bureau of Agricultural Engineering, U. S. Department of Agriculture, Iowa City, Ia.

Transfer of Grade

Wesley A. Harper, agricultural sales bureau, Caterpillar Tractor Co., Peoria, Ill. (Associate from Junior).

Bernard C. Taylor, rural department, Central Illinois Public Service Company, Springfield, Ill. (Junior from Student).